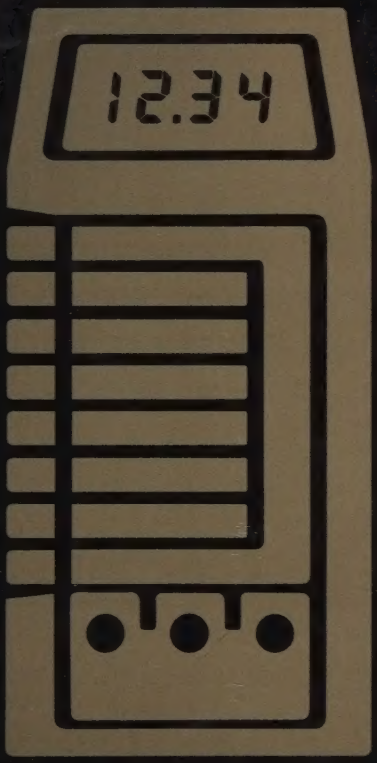
Instruction Manual

2-5-84

D800
Digital Multimeter



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NOTE

This manual documents the Model D 800 and its assemblies at the revision levels shown in Appendix A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix A for older assemblies.

See Section 5 for a complete listing of Fluke Service Centers.

D800
Digital Multimeter

Instruction Manual

P/N 583708
October 1980

FLUKE®

800

Digital Multimeter

Instruction Manual

FLUKE

Dear Customer:

Congratulations! We at Fluke are proud to present you with the Model D 800 Multimeter. This instrument represents the very latest in integrated circuit and display technology. As a result, the end product is a rugged and reliable instrument whose performance and design exhibit the qualities of a finely engineered lab instrument.

To fully appreciate and protect your investment, we suggest you take a few moments to read the manual. As always, Fluke stands behind your D 800 with a full one-year warranty and a worldwide service organization. If the need arises, please don't hesitate to call on us.

Thank you for your trust and confidence.

John Fluke Mfg. Co., Inc.

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Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2.. Your John Fluke Model D 800 is a pocket-sized digital multimeter that is ideally suited for application in the field, lab, shop or home. Your D 800 offers all standard VOM measurement functions: AC and DC volts, Alternating and Direct Current, and Resistance. Some of the features of your instrument are:

- 3½ digit liquid crystal display, a high contrast display that can be read easily from across the room. No more worries about bent needles, parallax, etc.
- Each range has:
  - Full auto-polarity operation.
  - Overrange indication.
  - Effective protection for overloads and transients.
- Dual slope integration measurement technique to insure fast, accurate, noise-free measurements.
- Long term calibration stability - 1 year. Easy calibration - few adjustments.
- Lightweight - 369 grams (13 ounces).
- Up to 200 hours of continuous operation can be expected from a single, inexpensive, 9V, alkaline battery (transistor radio/calculator type).
- Low battery voltage automatically detected and displayed.
- Line operation is possible using a Model A81Battery Eliminator (see Section 6, Accessories).
- Protected test leads - offer less chance of measured signal exposure at the DMM input terminals than standard banana test lead tips.
- A full line of accessories that extend the range and scope of your instrument.

1-3. ACCESSORIES

1-4. Table 1-1 lists the accessories available for use with the Model D 800 Detailed information about each accessory is provided in Section 6.

1-5. SPECIFICATIONS

1-6. Table 1-2 lists the D 800 specifications. These specifications assume a 1 year calibration cycle and an operating temperature of 18°C to 28°C (64°F to 82°F) at relative humidity up to 80% unless otherwise noted.

Table 1-1. D 800 Accessories

ACCESSORY	DESCRIPTION
A81-115	Battery Eliminator
C-90	Vinyl Carrying Case
80T-150C	Temperature Probe °C
80T-150F	Temperature Probe °F
80I-600	Current Transformer 2" jaws
80K-40	High Voltage Probe
80J-10	Current Shunt
81RF	High Frequency Probe
Y8100	AC/DC Current Probe
Y8101	Current Transformer 7/16" jaws
Y8132	Safety Designed Test Lead Set
Y8134	Deluxe Test Lead Set
Y8140	Slim Flex Test Lead Set

Table 1-2. D 800 Specifications

The following specifications assume a 1-year calibration cycle and an operating temperature of 18° C to 28° C (64° F to 82° F) at relative humidity up to 80%, unless otherwise noted.

FUNCTIONS ..... DC Volts, AC Volts, DC Current, Resistance

DC VOLTS

RANGE	RESOLUTION	ACCURACY for 1-Year
±200 mV	100 μV	±(0.5% of reading + 1 digit)
±2V	1 mV	
±20V	10 mV	
±200V	100 mV	
±1000V	1V	

Table 1-2. D 800 Specifications (cont)

Overvoltage Protection ..... 1000V dc or peak ac on all ranges.
Input Impedance ..... 10 MΩ, all ranges.
Normal Mode Rejection Ratio >60 dB at 50 Hz and 60 Hz.
Common Mode Rejection Ratio (1 kΩ unbalance) ..... >100 dB at dc, 50 Hz and 60 Hz.

AC VOLTS

RANGE	RESOLUTION	ACCURACY 45 Hz to 450 Hz
200 mV	100 μV	±(1% of reading +3 digits)
2V	1 mV	
20V	10 mV	
200V	0.1V	
750V	1V	

Overload Protection ..... 750V rms or 1000V peak continuous, except 200 mV ac ranges (15 seconds maximum above 300V rms ac).
Common Mode Noise Rejection Ratio (1 kΩ unbalance) ..... >60 dB at 50 Hz and 60 Hz.
Volt-Hz Product ..... 10^7 max (200V @ 50 kHz).
Input Impedance ..... 10 MΩ in parallel with <100 pf.

DC CURRENT

RANGE	RESOLUTION	ACCURACY for 1-Year	BURDEN VOLTAGE
2 mA	1 μA	±(1% of reading + 1 digit)	0.25V rms max
20 mA	10 μA		
200 mA	100 μA		
2000 mA	1 mA		0.9V rms max

Overload Protection ..... 2A/250V fuse, in series with a 3A/600V fuse.

RESISTANCE

RANGE	RESOLUTION	ACCURACY for 1-Year	FULL-SCALE VOLTAGE	MAXIMUM TEST CURRENT
200Ω	0.1Ω	±(0.3% of reading +3 digits)	<0.25V	.35 mA
2 kΩ	1Ω	±(0.2% of reading +1 digit)	>1.0V	1.1 mA
20 kΩ	10Ω		<0.25V	13 μA
200 kΩ	100Ω		>0.7V	13 μA
2000 kΩ	1 kΩ		<0.25V	0.13 μA
20 MΩ	10 kΩ	±(2% of reading +1 digit)	>.7V	0.13 μA

Table 1-2. D 800 Specifications (cont)

Overload Protection	500V dc/ac rms on all ranges.
Open Circuit Voltage	Less than 1.5V on all ranges except 2 kΩ range is less than 3.5V.
Diode Test	2 kΩ, 200 kΩ, and 20 MΩ ranges supply enough voltage to turn on junctions allowing a "Diode Test". 200 Ω, 20 kΩ, and 2000 kΩ ranges can make in-circuit measurements without turning on silicon juctions.

AC CURRENT

RANGE	RESOLUTION	ACCURACY for 1-Year 45 Hz to 450 Hz	BURDEN VOLTAGE
2 mA	1 μA	±(3% of reading +3 digits)	0.25V rms max.
20 mA	10 μA		
200 mA	100 μA		
2000 mA	1 mA		0.9V rms max.

Overload Protection ..... 2A/250V fuse, in series with a 3A/600V fuse.

ENVIRONMENTAL

Temperature	0°C to 50°C (32°F to 122°F) operating. -35°C to +60°C (-31°F to 140°F) storage.
Relative Humidity	0 to 80%, 0°C to 35°C (32-95°F) 0 to 70%, 35°C to 50°C (95-122°F)
Temperature Coefficient	<0.15 times the applicable accuracy specification per °C for 0°C to 18°C and 28°C to 50°C (32°F to 64.4°F and 82.4°F to 122°F).

GENERAL

Protection Class 2	Relates solely to insulation or grounding properties defined in IEC 348.
Maximum Common Mode Voltage	500V dc/rms ac.
BATTERY LIFE	Single 9V battery, NEDA 1604.
Alkaline	200 hours typical.
Zinc Carbon	100 hours typical.
BATTERY INDICATOR	"BT" on display illuminates when approximately 20% of battery life remains.
Display	3½ digit LCB (2,000 count), autozero, autopolarity.
Size	L x W x H: 18.0 cm x 8.6 cm x 4.5 cm (7.1 in x 3.4 in x 1.8 in)
Weight	0.37 kg. (13 oz)

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. To fully utilize the measurement capabilities of your D 800 a basic understanding of its measurement techniques and limitations is required. This section of the manual provides that information. For additional application or operation literature, write or call the John Fluke Mfg. Co., Inc.; P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211.

2-3. PREPARING FOR OPERATION

2-4. Unpacking

2-5. Your D 800 was packed and shipped in a container especially designed to protect your DMM. This manual, your multimeter, one 9V battery, and two test leads (one red and one black) should be packed in the shipping container. Check your shipment thoroughly. If anything is wrong with your shipment, or if your instrument was damaged during shipping, contact the place of puchase immediately. If satisfaction is not obtained, contact the nearest John Fluke Service Center. A list of these service centers is located at the rear of this manual.

2-6. If reshipment is necessary, please use the original shipping container. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please state the instrument model number when requesting a new shipping container.

2-7. Battery or Fuse Installation/Replacement

2-8. Your D 800 is designed to operate on a single, inexpensive, 9V battery of the transistor radio/calculator variety (NEDA 1604). When you receive your D 800 battery will not be installed in the DMM. Once the battery is installed, you can expect a typical operating life of up to 200 hours with an alkaline battery or 100 hours with a carbon-zinc battery. When the battery has exhausted about 80% of its useful life, the BT indicator will appear in the upper left corner of the display. Your D 800 will operate properly for at least 20 hours after BT appears. Use the following procedure to install or replace the battery or Fuse F1.

CAUTION

To ensure operation within the accuracy specifications, the battery should be replaced when the voltage measured at the center of the battery eliminator connector falls below -3.00 volts (with respect to the COMMON input). If the battery voltage falls to a point where the "BT" is displayed and the digital display is inactive or no longer responds to a signal input, the battery should be replaced immediately to prevent damage to the LCD.

WARNING

BATTERY OR FUSE REPLACEMENT SHOULD ONLY BE PERFORMED AFTER THE INPUT SIGNAL AND TEST LEADS HAVE BEEN REMOVED FROM THE INPUT TERMINALS, AND THE POWER SWITCH IS SET TO OFF.

1. Set the D 800 power switch to OFF.

2. Remove test leads from external circuit connections and from the D 800 input terminals.

3. Open the battery compartment on the bottom of the D 800 using the method shown in Figure 2-1.

4. Tilt the battery out as shown in Figure 2-2.

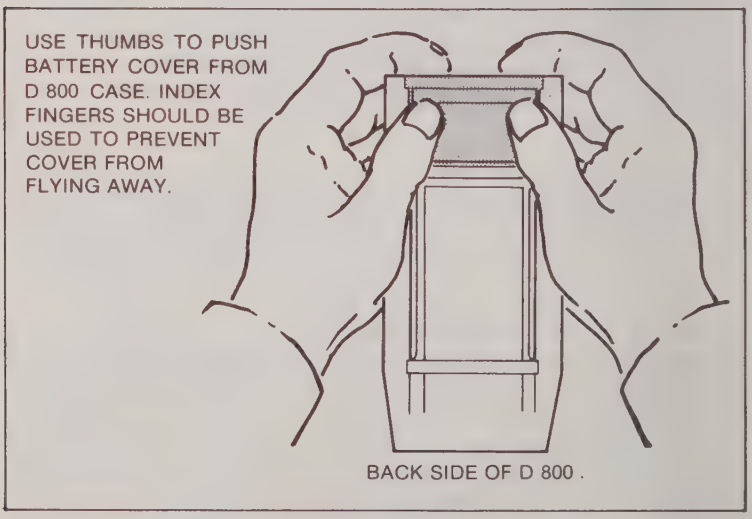

USE THUMBS TO PUSH BATTERY COVER FROM D 800 CASE. INDEX FINGERS SHOULD BE USED TO PREVENT COVER FROM FLYING AWAY.
BACK SIDE OF D 800 .

Figure 2-1. Removing Battery Cover

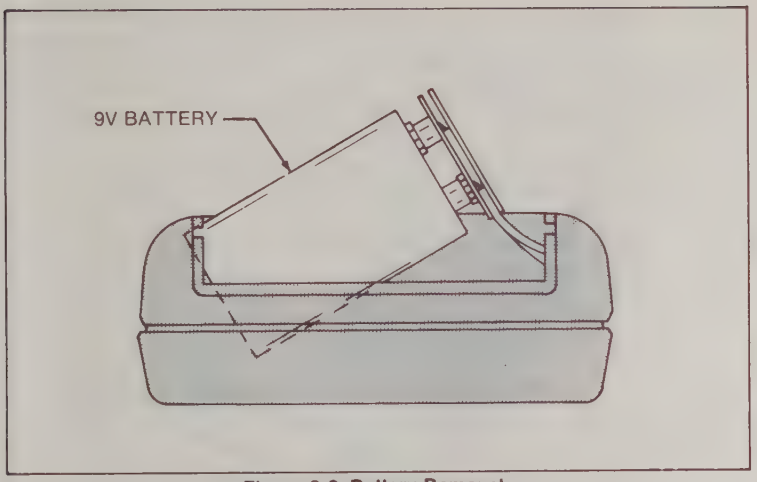


Figure 2-2. Battery Removal

5. If fuse F1 is to be replaced, use a pointed tool, such as a probe tip or small screwdriver to pry F1 from its holder. Replace the defective fuse with type AGX2.

6. Carefully pull the battery clip free from the battery terminals as shown in Figure 2-2.

7. Press the battery clip onto the replacement battery and return both to the battery compartment.

8. Make sure the battery and its leads are fully within the confines of the battery compartment before sliding the cover into place.

WARNING

DO NOT OPERATE THE D 800 UNTIL THE BATTERY COVER IS IN PLACE AND FULLY CLOSED,

2-9. PHYSICAL FEATURES

2-10. Before you try to use your D 800 we suggest that you take a few minutes to get acquainted with your instrument. All of the externally accessible physical features of your D 800 are shown in Figure 2-3 and described in Table 2-1. Locate each feature on your D 800 as you read the description.

2-11. OPERATING NOTES

2-12. The following paragraphs should familiarize you with the capabilities and limitations of your Model D 800 and instruct you in routine operator maintenance.

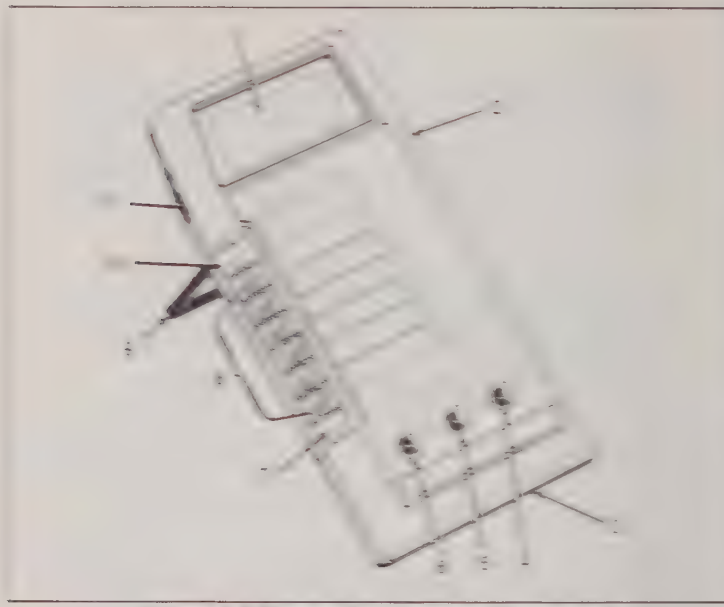


Figure 2-1. Controls, Indicators and Connectors

Table 2-1. Controls, Indicators and Connectors

ITEM NO.	NAME	FUNCTION
1	Display	4 1/2 digit display with decimal point and minus polarity indication. Used to indicate measured input value, overrange condition and low battery condition.
2	Battery Eliminator Connector	An external input power connector for use with the Model 45 Battery Eliminator accessory. Will accept a variety of voltage and plug configurations. See Section 6.
3	Battery Compartment and Cover	Cover for the 9V battery and the current-protector fuse. The cover is removed by pushing it away from the case screw.
4	[illegible] Connector	Protected test lead connector used as the high input for all voltage and resistance measurements. This

Table 2-1. Controls, Indicators and Connectors (cont)

ITEM NO.	NAME	FUNCTION
4	(cont)	connector will accept standard banana plugs.
5	COMMON Input Connector	Protected test lead connector used as the low or common input for all measurements. This connector will accept standard banana plugs.
6	mA Input Connector	Protected test lead connector used as the high input for all current measurements. This connector will accept standard banana plugs.
7	mA/V-Ω Switch	A push-push switch (push on - push off, do not pull to select function) which operates in conjunction with the high input connectors to select either the mA/V or Ω measurement functions. When in or depressed it selects Ω. The out position selects mA or V depending upon the location of the high input lead.
8	Range Switches	Interlocked push-button switches for selecting ranges, i.e., pressing the desired range switch selects that range and cancels previous switch depressions. Do not pull switches to select a range. Voltage: 200 mV, 2V, 20V, 200V, 1000V dc/750V ac Current: 2 mA, 20 mA, 200 mA, 2000 mA Resistance: 200Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ
9	Tilt Bail	A removable fold-out stand which allows the instrument to be either tilted for bench-top applications or hung from a hook in the absence of a work surface.
10	DC/AC Switch	A push-push switch (push on - push off, do not pull to select function) used to select the ac or dc measurement function when measuring current or voltage. When in, or depressed, the ac function is selected. Out selects dc.

Table 2-1. Controls, Indicators and Connectors (cont)

ITEM NO.	NAME	FUNCTION
10	(cont)	Switch may be in either position when making resistance measurements.
11	Power Switch	A slide switch used to turn the instrument off and on.

2-13. Input Overload Protection

CAUTION

Exceeding the maximum input overload limits can damage your instrument. The transient overload protection circuit is intended to protect against short duration high energy pulses. The components used limit the protection to approximately five pulses per second for 6 KV 10microsecond pulses, and about 0.6 watts average for lower amplitude pulses. Fast repetition rate pulses as from a TV set can damage the protection components; RV1 - RV4, R1 and R2*, if replaced, use only Fluke replacement parts to maintain product safety.

*** R2 is a fusable resistor. Use exact replacement to insure safety.**

2-14. Each measurement function and its associated ranges are equipped with input overload protection. The overload limits for each function and range are given in Table 2-2.

2-15. Input Connections To COMMON

WARNING

TO AVOID ELECTRICAL SHOCK AND /OR INSTRUMENT DAMAGE DO NOT CONNECT THE COMMON INPUT TERMINAL TO ANY SOURCE OF MORE THAN 500 VOLTS DC OR RMS AC ABOVE EARTH GROUND.

2-16. The D 800 may be operated with the COMMON input terminal at a potential of up to 500V dc or 500V rms ac above earth ground. If this limit is exceeded, instrument damage may occur. This, in turn, may result in a safety hazard for the operator.

2-17. Fuse Check

2-18. The current (mA) function contains two fuses. Check them as follows:

1. Complete the set up steps for the RESISTANCE (Ω) function and select the 2 kΩ range.

2. Touch the red test probe to the mA input jack so that the V-Ω input and mA input are connected together.

Table 2-2. Model D 800 Overload Limits

SELECTED FUNCTION	SELECTED RANGE	INPUT CONNECTIONS	MAX INPUT OVERLOAD
V dc or V ac	200 mV, 2V, 2V, 200V, 750V ac, 1000V dc	V/Ω and COMMON	1000V dc or peak ac on dc ranges. 1000V dc or 750V rms on ac ranges - 15 seconds max above 300V on 200 mV ac range
mA dc or mA ac	2 mA, 20 mA, 200 mA, 2000 mA	mA and COMMON	2A max. Fuse protected in circuits with open voltage ≤600V dc/rms ac Do not use above 600V dc or rms ac
Ω	200Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ	V/Ω and COMMON	500V dc or rms ac
ANY	ANY	COMMON	500V dc/rms ac with respect to earth ground

3. If the display reads approximately .100 kΩ, both fuses are good.

4. If the display reads overrange 1 followed by blank digits, one or both fuses need replacement. See the following paragraphs for replacement instructions.

2-19. FUSE REPLACEMENT

2-20. All ac and dc current ranges are fuse protected. Two series fuses are used: (1) F1, 2A @ 250V, replaceable at the battery compartment (see section 1 "Battery or Fuse Installation/Replacement") and (2) F2, 3A @ 600V backup fuse (see section 4 "Battery/Backup Fuse Replacement").

2-21. The Display

2-22. The Front Panel Display on your D 800 is a 3½ digit Liquid Crystal Display. The The ½ digit is the extreme left digit location. So, the displayed value can range from 000 through 1999. Forconvenience, in discussion, the 1999 is rounded to 2000. The decimal point position is determined by selected range and is not affected by the measurement function selected. Polarity, on the other hand is only used for the dc voltage and current measurement functions. A minus sign indicates that the input signal is negative with respect to the COMMON input terminal. Positive inputs are indicated by the absence of the minus sign.

NOTE

The minus sign (–) may flash momentarily as the D 800 comes out of an overrange condition. This will most likely be seen in the ohms mode as the open circuit test leads are applied to an in-range resistance value. If the minus sign remains on for in-range ohms readings, the circuit is live (a negative voltage is present at the input terminals due to charged capacitors, etc.) and incorrect resistance readings will be observed.

2-23. The Display has two abnormal status indicators, low battery power and instrument overrange. a "BT" is displayed when approximately 80% of the battery's life is exhausted (battery replacement is indicated). And, a "1" followed by three blanked digits is displayed (decimal point may be present) as an overrange indication. This does not necessarily mean that the instrument is being exposed to a damaging input condition. For example, when measuring resistance an open-input will cause an overrange indication.

NOTE

When the D 800 is powered with the A81 battery eliminator the "BT" indicator may come on. However, instrument operation will remain normal.

2-24. The liquid crystal display used in the D 800 is a rugged and reliable unit which will give years of satisfactory service. Display life can be extended by observing the following practices:

1. Protect the display from extended exposure to bright sunlight.

2. Keep the voltmeter out of high temperature, high humidity environments, such as, the dash of a car on a hot, sunny day, otherwise the display may temporarily turn black. Recovery occurs at normal operating temperature.

3. Note that the display operation may be slowed in extremely low temperature environments. No damage will occur to the LCD, but response time is greatly increased. Recovery occurs at normal operating temperature.

2-25. OPERATION

2-26. The five figures, 2-4 through 2-8, each illustrate one of the five measurement functions of the Model D 800. Each figure has two parts. The top part shows your D 800 as it should look when ready to perform that type of measurement. The bottom part of the figure lists, insequential order, the steps you should perform to make that type of measurement with your D 800. To operate your D 800 turn to the OPERATION figure corresponding to the measurement function desired and perform the steps listed in the figure. Operate the Model D 800 in accordance with the Input Overload Protection and the Input Connections to COMMON portions of the Operating Notes presented earlier in this section.

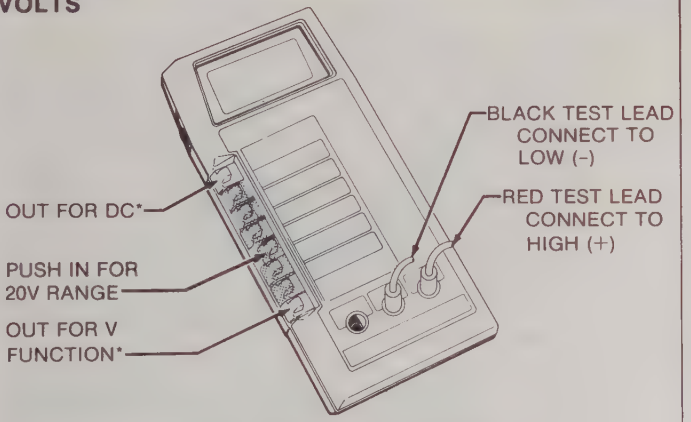
2-27. INITIAL CHECK-OUT PROCEDURE

2-28. Now that you have installed the battery, and know where everything is, and how it works, let's make sure that the unit is working properly. We'll run through a simple check-out procedure starting with turn-on. No equipment other than test leads will be required. If a problem is encountered, please check the battery, fuse, switch settings, and test lead connections before contacting your nearest John Fluke Service Center.

NOTE

This procedure is intended to verify overall instrument operation, and is not meant as a substitute for the formal Performance Test given in Section 4. Limits shown exceed the specifications because the procedure uses one measurement function to check another.

DC VOLTS



**NOTE: Both of the function switches are push-push type switches. Do not try to pull these switches to the out position.*

- Plug the Red Test Lead into the V-Ω terminal
- Plug the Black Test Lead into the COMMON terminal
- Push, to the in position, the range switch corresponding to the desired range of measurement. The 20V range is shown selected.
- Insure that all other pushbuttons are at the out position.

WARNING

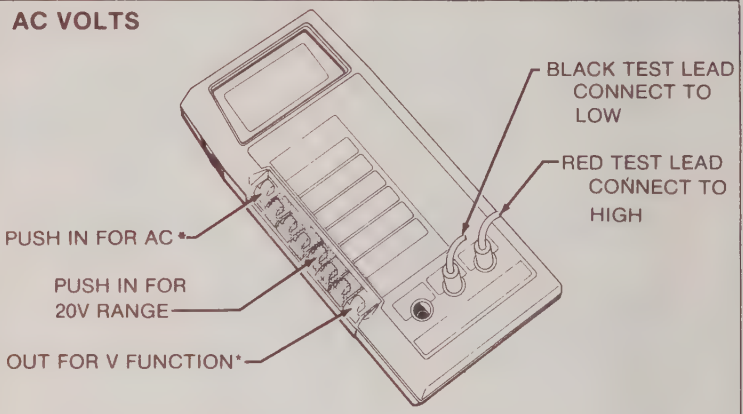
TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE D 800 TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING DC VOLTAGE:

COMMON: 500V DC/AC RMS WITH RESPECT TO EARTH GROUND.
V-Ω: 1000V DC OR 750V AC RMS WITH RESPECT TO THE COMMON TERMINAL.

- Connect the Test Leads to the circuit being measured.
- Read the measured value in the Display.

Figure 2-4. DC Volts (DC V) Operation

AC VOLTS



**NOTE: Both of the function switches are push-push type switches. Do not try to pull these switches to the out position.*

- Plug the Red Test Lead into the V-Ω terminal.
- Plug the Black Test Lead into the COMMON terminal.
- Push the AC-DC pushbutton to the in position.
- Push, to the in position, the range switch corresponding to the desired range of measurement. The 20V range is shown selected.
- Insure that all other pushbuttons are at the out position.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE D 800 TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHENMEASURING AC VOLTAGE:

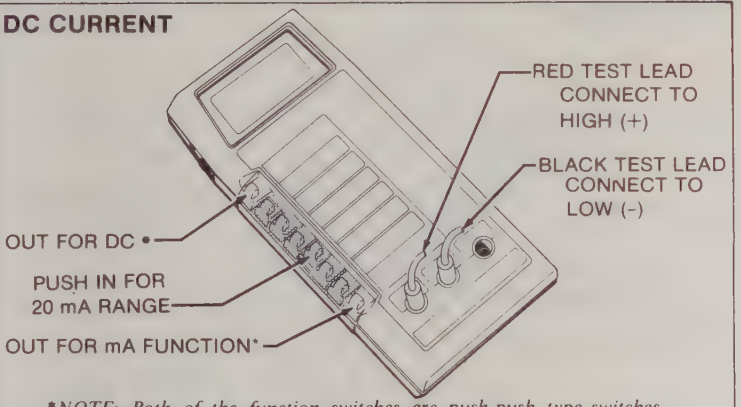
COMMON: 500V DC/AC RMS WITH RESPECT TO EARTH GROUND.

V-Ω: 1000V DC OR 750V AC RMS WITH RESPECT TO THE COMMON TERMINAL (IN THE AC FUNCTION, 200 mV RANGE, SOURCES GREATER THAN 300V AC RMS SHOULD NOT BE CONNECTED LONGER THAN 15 SECONDS).

- Connect the Test Leads to the circuit being measured.
- Read the measured value in the Display.

Figure 2-5. AC Volts (AC V) Operation

DC CURRENT



**NOTE: Both of the function switches are push-push type switches. Do not try to pull these switches to the out position.*

- Plug the Red Test Lead into the mA terminal.
- Plug the Black Test Lead into the COMMON terminal.
- Push, to the in position, the range switch corresponding to the desired range of measurement. The 20 mA range is shown selected.
- Insure that all other pushbuttons are at the out position.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE D 800 TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING DC CURRENT:

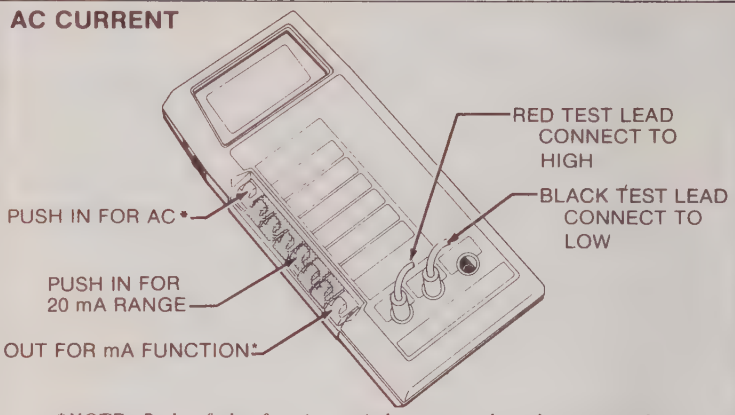
COMMON: 500V DC OR AC RMS WITH RESPECT TO EARTH GROUND.
mA: CURRENT OF 2 AMPS OR OPEN CIRCUIT VOLTAGE OF 600V DC/AC RMS.

DO NOT ATTEMPT CURRENT MEASUREMENT WHERE THE POTENTIAL IS ABOVE 600V DC OR AC RMS.

- Connect the Test Leads to the circuit being measured.
- Read the measured value in the Display.
- If unit fails to read properly, see FUSE CHECK instructions located earlier in this section.

Figure 2-6. Direct Current (DC mA) Operation

AC CURRENT



**NOTE: Both of the function switches are push-push type switches. Do not try to pull these switches to the out position.*

- Plug the Red Test Lead into the mA terminal.
- Plug the Black Test Lead into the COMMON terminal.
- Push the AC-DC pushbutton to the in position.
- Push, to the in position, the range switch corresponding to the desired range of measurement. The 20 mA range is shown selected.
- Insure that all other pushbuttons are at the out position.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE D 800 TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING AC CURRENT:

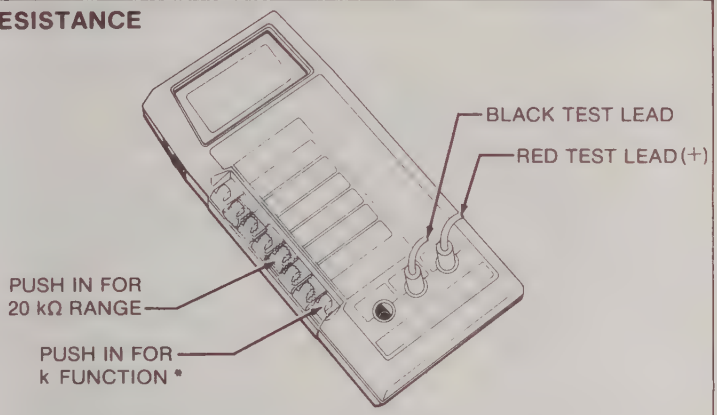
COMMON: 500V DC/AC RMS WITH RESPECT TO EARTH GROUND.
mA: CURRENT OF 2 AMPS OR OPEN CIRCUIT VOLTAGE OF 600V DC/AC RMS.

DO NOT ATTEMPT CURRENT MEASUREMENT WHERE THE POTENTIAL IS ABOVE 600V DC OR AC RMS.

- Connect the Test Leads to the circuit being measured.
- Read the measured value in the display.

Figure 2-7. Alternating Current (AC mA) Operation

RESISTANCE



**NOTE: Both of the function switches are push-push type switches. Do not try to pull these switches to the out position.*

- Plug the Red Test Lead into the V-Ω terminal.
- Plug the Black Test Lead into the COMMON terminal.
- Push the mA/V-Ω pushbutton to the in position.
- Push, to the in position, the range switch corresponding to the desired range of measurement. The 20 kΩ is shown selected.
- Insure that all other pushbuttons are at the out position.
- Make sure the device being measured contains no electrical energy.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE D 800 TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING RESISTANCE:

COMMON: 500V DC/AC RMS WITH RESPECT TO EARTH GROUND.
V-Ω: 500V DC OR AC RMS WITH RESPECT THE COMMON TERMINAL.

- Connect the test leads across the device being measured.
- Read the measured value in the Display.

Figure 2-8. Resistance (Ω) Operation

1. Set the power switch to OFF and all range and function switches to the released (out) position.

2. Set the power switch to ON and observe the display. It should read 00.0 ±0.1.

3. Connect the red test lead to the V/Ω input terminal.

4. Touch the red probe tip to the COMMON input terminal, and sequentially depress each of the six range switches starting at the top (20 MΩ). The display should read zero ±1 digit and the decimal point should be positioned as follows:

a. 20 M - 0.00
b. 2000 k - 000
c. 200 k - 00.0
d. 20 k - 0.00
e. 2 k - .000
f. 200Ω - 00.0

5. Press the 20V range switch and remove the probe from the COMMON input terminal.

6. Depress the lower function button (Ω) and sequentially depress each of the six ranges switches. The display should read 1 as the most significant digit with no other numbers shown. This is the standard overrange indication. Notice that the decimal point changes poistion withthe range switch settings just as it did in step 4 of this procedure.

7. Touch the red probe tip to the COMMON input terminal, and sequentially press each of the range buttons. The display should read zero at each range setting. Lead resistance may be sufficient to cause a one or two tenths (0.1 or 0.2Ω) indication on the 200Ω range.

8. Touch the red probe tip to the mA input connector and press the 200Ω switch. The display should read 99.0 to 101.0.

9. Select the 2 kΩ range. The display should read .099 to .101. Remove the probe from the mA input connector.

10. Depress both the AC/DC switch and the 750V ac range switch. Set the mA/V-Ω switch to the voltage (out) position.

WARNING

THE LOCAL LINE VOLTAGE IS MEASURED IN THE FOLLOWING STEP. BE CAREFUL NOT TO TOUCH THE PROBE TIPS WITH FINGERS, OR TO ALLOW THE PROBE TIPS TO CONTACT EACH OTHER.

11. Measure the local ac line voltage at a convenient output receptacle. The voltage should be displayed with 1 volt resolution.

12. If the D 800 has responded properly to this point, it is operational and ready for use.

2-29. MEASUREMENT TECHNIQUES

2-30. The concluding paragraphs of this section offer you techniques that improve the measurement accuracy of your D 800. While these techniques are in general use throughout the electronics industry, these paragraphs offer specific information for use with your D 800.

2-31. AC Measurement

2-32. The ac ranges of the D 800 employ an average responding ac converter. This means that the unit measures the average value of the input, and displays it as an equivalent rms value for a sine wave. As a result, measurement errors are introduced when the input wave form is distorted (non-sinusoidal). The amount of error depends upon the amount of distortion. Figure 2-9 shows the relationship between sine, square and triangular waveforms, and the required conversion factors.

2-33. Voltage AC/DC

2-34. The D 800 is equipped with five ac and five dc voltage ranges; 200 mV, 2V, 20V, 200V, 750V ac 1000V dc. All ranges present an input impedance of 10 MΩ. On the ac ranges, this is shunted by less than 100 pF. When making measurements, be careful not to exceed the overload limits given earlier in Table 2-2.

2-35. Measurement errors, due to circuit loading, can result when making either ac or dc voltage measurements on circuits with high source resistance. However, in most cases the error is negligible (≤0.1%) as long as the source resistance of the measurement circuit is 10 kΩ or less. If circuit loading does present a problem, the percentage of error can be calculated using the appropriate formula in Figure 2-10.

2-36. Current AC/DC

WARNING

INSTRUMENT DAMAGE AND OPERATOR INJURY MAY RESULT IF THE FUSE BLOWS WHILE CURRENT IS BEING MEASURED IN A CIRCUIT WHICH EXHIBITS AN OPEN CIRCUIT VOLTAGE GREATER THAN 600V. DO NOT ATTEMPT IN-CIRCUIT CURRENT MEASUREMENT WHERE THE POTENTIAL IS GREATER THAN 600V DC OR AC RMS.

2-37. Four ac and four dc current ranges are included on the D 800; 2 mA, 20 mA, 200 mA and 2000 mA. Each range is diode protected to 2 amps and fuse protected above 2 amps. If a fuse blows, refer to fuse check and replacement information given earlier in this section.

2-38. In high electrical noise environments (near ignition switches, flourescent lights, relay switches, etc.) unstable or erroneous readings (exceeding specifications) may occur. The effect is most obvious when measuring low level current on the 2 mA range. If an erratic or erroneous reading is suspected, temporarily jumper the V/Ω connector to the mA connector. This will ensure an accurate measurement.

CAUTION

To avoid possible instrument damage and/or erroneous measurements remove the temporary V/Ω-to-mA jumper before attempting voltage or resistance measurements.

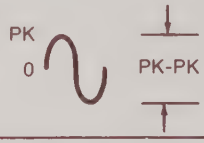
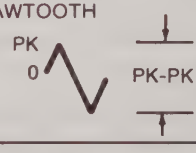
INPUT WAVEFORM	DISPLAY MULTIPLIER FOR MEASUREMENT CONVERSION			
	PK-PK	0-PK	RMS	AVG
SINE 	2.828	1.414	1.000	0.900
RECTIFIED SINE (FULL WAVE)	1.414	1.414	1.000	0.900
RECTIFIED SINE (HALF WAVE)	2.828	2.828	1.414	0.900
SQUARE	1.800	0.900	0.900	0.900
RECTIFIED SQUARE	1.800	1.800	1.272	0.900
RECTANGULAR PULSE D=X/Y	0.9/D	0.9/D	$0.9/D^{1/2}$	0.9D
TRIANGLE SAWTOOTH 	3.600	1.800	1.038	0.900

Figure 2-9. Waveform Conversion

1. DC VOLTAGE MEASUREMENTS

Loading Error in % = 100 x Rs ÷ (Rs + 10^7)
Where: Rs = Source resistance in ohms of circuit being measured.

2. AC VOLTAGE MEASUREMENTS

First, determine input impedance, as follows:*

$$Z\,in = \frac{10^7}{\sqrt{1 + (2\pi F \cdot Rin \cdot C)^2}}$$

Where: Zin = effective input impedance
Rin = 10^7 ohms
Cin = 100 x 10^{-12} Farads
F = frequency in Hz

Then, determine source loading error as follows:*

$$\text{Loading Error in \%} = 100 \times \frac{Zs}{Zs + Zin}$$

Where: Zs = source impedance
Zin = input impedance (calculated)

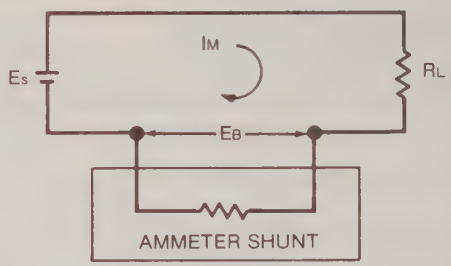
* Vector algebra required.

Figure 2-10. Voltage Measurement Error Calculations (Loading Error)

2-39. Full-scale burden voltage (voltage drop across the fuse and current shunt) for all ranges except 2000 mA is less than 250 mV. The 2000 mA range has a full-scale burden voltage of less than 900 mV. These voltage drops can affect the accuracy of a current measurement, if the current source is unregulated and the shunt plus fuse resistance represents a significant portion (1/1000 or more) of the source resistance. If burden voltage does present a problem, the percentage of error can be calculated using the formula in Figure 2-11. This error can be minimized by using the highest current range that gives the necessary resolution. For example, if 20 mA is measured on the 2000 mA range the burden voltage is approximately 5 mV.

2-40. Resistance

2-41. Six direct reading resistance scales are provided on the D 800; 20 MΩ, 2000 kΩ, 200 kΩ, 20 kΩ, 2 kΩ and 200Ω. All scales employ a two wire measurement techniques. As a result, test lead resistance may influence measurement accuracy on the 200Ω range. To determine the error, short the test leads together and read the lead resistance. Correct the measurement by subtracting the lead resistance from the unknown reading. The error is generally on the order of 0.2 to 0.3 ohms for a standard pair of test leads.



E_S = Source voltage
R_L = Load resistance + Source resistance
I_M = Measured current (display reading in mA)
E_B = Burden voltage (calculated), i.e., Display reading expressed as a % of full-scale ($100 \times \frac{\text{READING}}{\text{FULL-SCALE}}$) times full-scale burden voltage for selected range. See Table.

RANGE	MAXIMUM BURDEN VOLTAGE
2 mA to 200 mA	0.25V
2000 mA	0.9V

current error due to Burden Voltage

$$\text{IN \%} = 100 \times \frac{E_B}{E_S - E_B}$$

$$\text{IN mA} = \frac{E_B \times I_M}{E_S - E_B}$$

Example: $E_S = 14V$, $R_L = 9\Omega$, $1M = 1497$ mA,

$$EB = 100 \times \frac{1497}{2000} \times 0.9 \text{ (from Table)} =$$

74.9% or $0.9 = 0.674V$

$$\text{Error in \%} = 100 \frac{.674}{14 - .674} = 100 \frac{.674}{13.48} = 5.06\%$$

Increase displayed current by 5.06% to obtain true current.

$$\text{Error in amps} = \frac{.524 \times 1497}{14 - .674} = \frac{784}{13.236} = 74 \text{ mA}$$

Increase displayed current by 74 mA to obtain true current.

Figure 2-11. Current Measurement Error Calculations

2-42. The three resistance ranges with a diode symbol beside the range value have a high enough open circuit voltage to turn a silicon junction on. These ranges - 2 kΩ, 200 kΩ, and 20 MΩ - can be used to check silicon diodes and transistors. The 2 kΩ range is preferred; it is marked with the largest diode symbol. On the ranges not marked with a diode symbol, the full scale voltage is not high enough to turn a silicon junction on. Use these ranges to make in circuit resistance measurements. Maximum full scale voltage and short circuit current for each resistance range is given in Table 2-3. All values shown are referenced to the COMMON input terminal; i.e., the V/Ω terminal is positive.

NOTE

Any change (greater than one or two digits) in apparent resistance when test leads are reversed may indicate either the presence of a diode junction or a voltage in the circuit.

CAUTION

Turn test circuit power off and discharge all capacitors before attempting in-circuit resistance measurements.

Table 2-3. Voltage/Current Capability of Resistance Ranges

RANGE	FULL-SCALE VOLTAGE (TYPICAL)	SHORT CIRCUIT CURRENT (TYPICAL)
20 MΩ-▶|-	+800 mV	+0.12 μA
2000 kΩ	+200 mV	+0.12 μA
200 kΩ-▶|-	+800 mV	+12 μA
20 kΩ	+200 mV	+12 μA
2 kΩ-▶|-	+1.1V	+1.0 mA
200Ω	+55 mV	+0.3 mA

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description followed by a block diagram analysis of the D 800. A detailed schematic of the D 800 appears in Section 7.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. The Model D 800 as shown in Figure 3-1, is a hand-held five function digital multimeter. It features a total of 24 measurement ranges (V dc, 5; V ac 5; Ω, 6; mA dc, 4; and mA ac, 4), a high contrast easy-to-read, 3½ digit, liquid crystal display, long battery life (up to 200 hours); and overload protection for all ranges.

3-5. Operation centers around a custom LSI chip, U8, which is composed a dual slope a/d converter and a display driver. Peripherals to U8 include range and function switches, input signal conditioners and the display. When an input signal is applied to the D 800, it is routed through the range switches to one-of-four input signal conditioners as determined by the function switch setting. Each conditioner scales and, if necessary, rectifies the input so that an acceptable dc input level (-0.2 to +0.2V dc) is presented to the a/d converter.

3-6. Timing for the overall operation of the a/d converter is derived from an external quartz crystal whose frequency is a multiple of the local line frequency. This allows the conditioned dc input data to be integrated over a single line cycle, thus, optimizing both common mode and normal mode rejection.

3-7. Digitized measurement data is presented to the display as four decoded digits (seven segments) plus polarity. Decimal point position on the display is determined by the range switch settings.

3-8. BLOCK DIAGRAM ANALYSIS

3-9. A/D Converter

3-10. The entire analog-to-digital conversion process is accomplished by a single custom a/d converter and Display Driver IC, U8. The IC employs the dual slope method of a/d conversion, and requires a series of external components to establish the basic timing and referenece levels required for operation. These include an integrating capacitor, an autozero capacitor, and a flying capacitor (for applying a reference level of either polarity). Since the power consumed for display operation is very low, the a/d converter IC also contains the display latches, decoders and drivers.

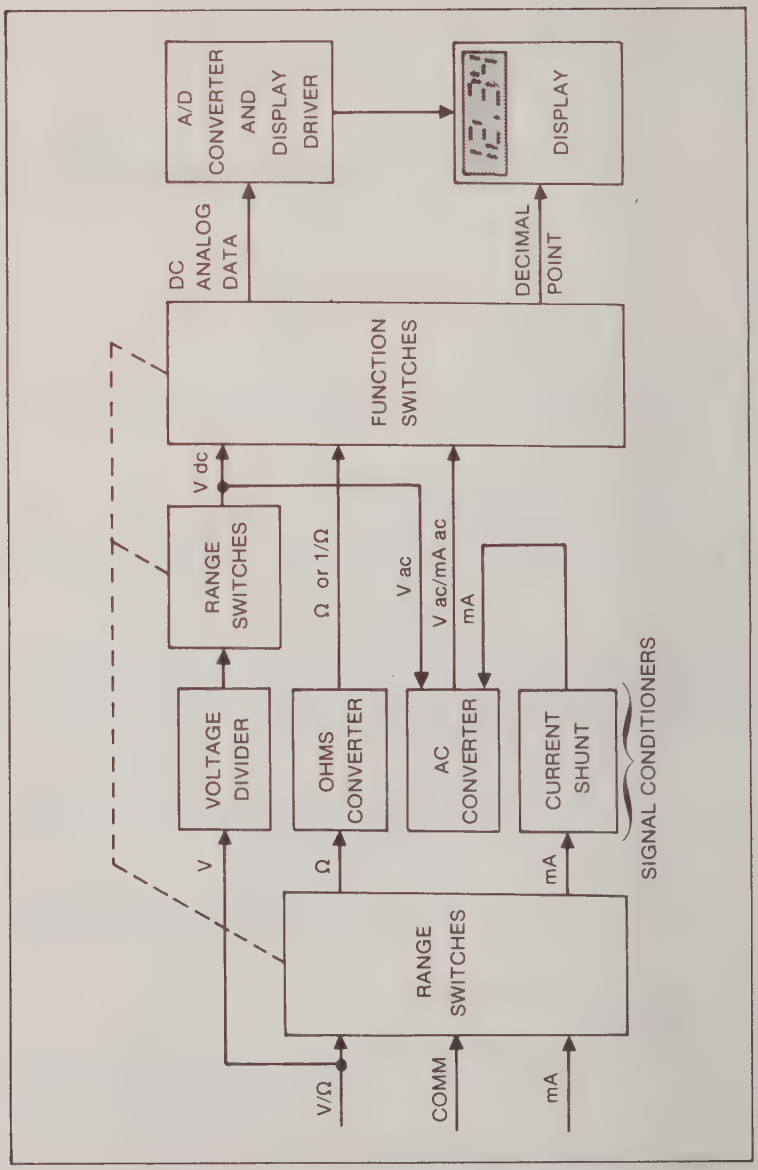


Figure 3-1. Model D800 Simplified Block Diagram

3-11. The digital control portion of the a d conversion process is an internal function of U8, and is keyed to the external crystal frequency. As a result, the conversion process is continuously repeated, and the display is updated at the end of every conversion cycle.

3-12. A simplified circuit diagram of the analog portion of the a d converter is shown in Figure 3-2. Each of the switches shown represent analog gates which are operated by the digital section of the a d converter. Basic timing for switch operation and, therefore, a complete measurement cycle is also included in the figure.

3-13. Any given measurement cycle performed by the a d converter can be divided into three consecutive time periods, autozero (AZ), integrate (INTEG), and read. Both autozero and integrate are fixed time periods whose lengths are multiples of the clock frequency. A counter determines the length of both itme periods by providing an overflow at the end of every 10,000 clock pulses. The read period is a variable time which is proportional to the unknown input voltage. The value of the voltage is determined by counting the number of clock pulses that occur during the read period.

3-14. During autozero a ground reference is applied as an input to the a d converter. Under ideal conditions the output of the comparator would also go to zero. However, input-offset-voltage errors accumulate in the amplifier loop, and appear at the comparator output as an error voltage. This error is impressed across the AZ capacitor where it is stored for the remainder of the measurement cycle. The stored level is used to provide offset votlage correction during the integrate and read periods.

3-15. The integrate period begins at the end of the autozero period. As the period begins, the AZ switch opens and the INTEG switch closes. This applies the unknown input voltage to the input of the a/d converter. The voltage is buffered and passed on to the integrator to determine the charge rate (slope) on the INTEG capacitor. At the end of the fixed integrate period the capacitor is charged to a level proportional to the unknown input voltage. This voltage is translated to a digital indication by discharging the capacitor at a fixed rate during the read period, and counting the number of clock pulses that occur before it returns to the original autozero level.

3-16. As the read period begins, the INTEG switch opens and the read switch closes. This applies a known reference voltage to the input of the a d converter. The polarity of this voltage is automatically selected to be opposite that of the unknown input voltage, thus, causing the INTEG capacitor to discharge at a fixed rate (slope). When the charge is equal to the initial starting point (autozero level), the read period is ended. Since the discharge slope is fixed during the read period, the time required for discharge is proportional to the unknown input voltage.

3-17. The autozero period and, thus, a new measurement cycle begins at the end of the read period. At the same time the counter is released for operation by transferring its contents (previous measurement value) to a series of latches. This stored data is then decoded and buffered before being used for driving the liquid crystal display.

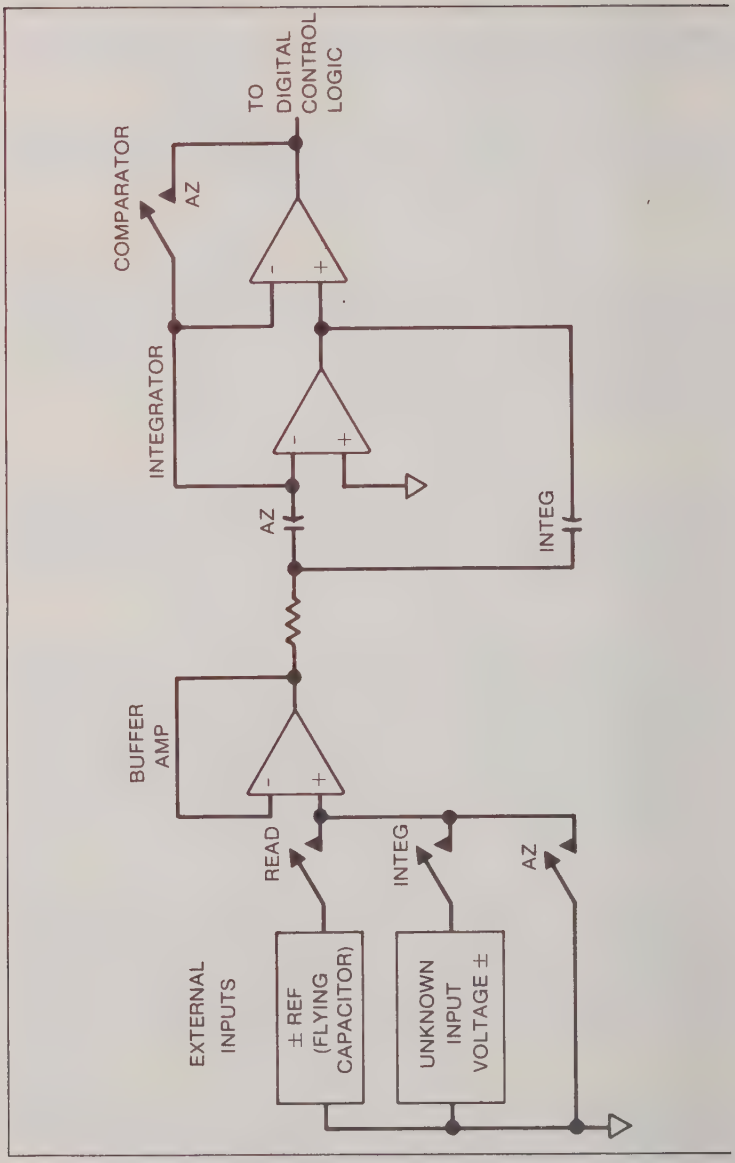


Figure 3-2. Dual Slope A/D Converter

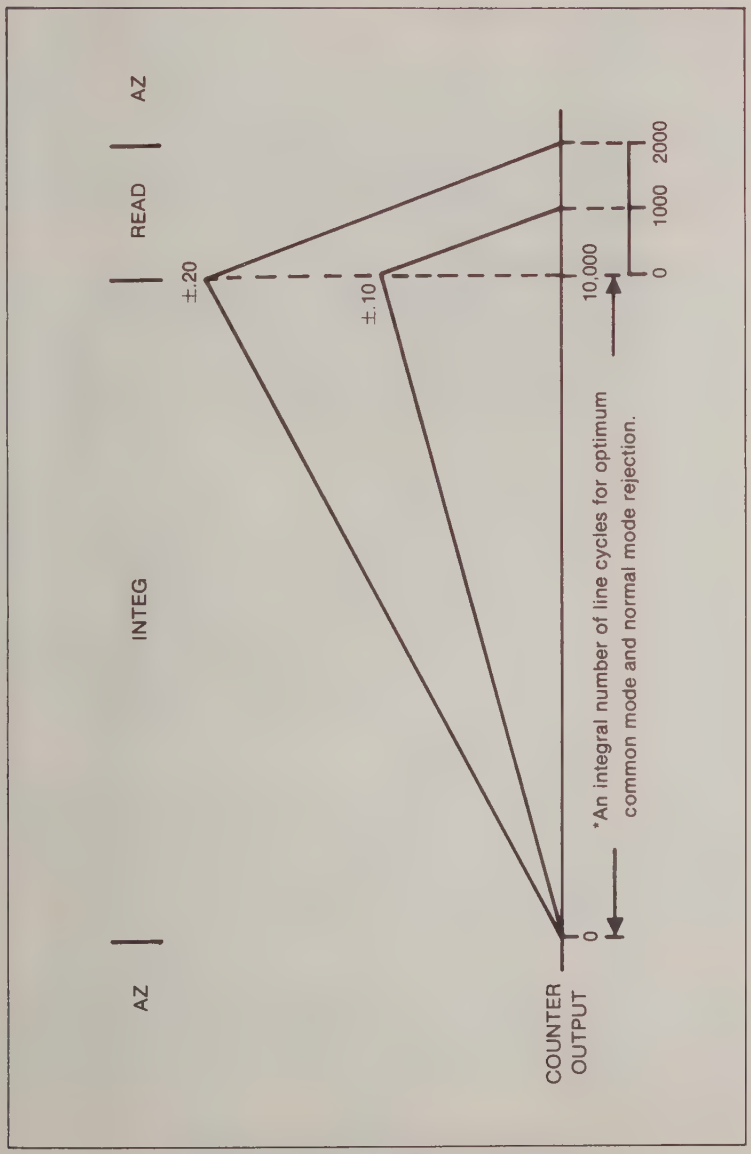


Figure 3-2. Dual Slope A/D Converter (cont)

3-18. Input Signal Conditioners

3-19. The a d converter requires two externally supplied inputvoltages to complete a measurement cycle. One is reference voltage and the other is an unknown dc voltage within the range of 0.2 to +0.2V dc. If the function being measured is other than a dc voltage within the ±0.2 range, it must be scaled and or conditioned before being presented to the a d converter. for example,m higher dc levels must be divided; ac inputs must be divided, rectified, and filtered; and resistance and current inputs must be scaled and converted to dc voltlage levels. The following paragraphs describe the input signal conditioners used for each of the D 800 measurement functions. The descriptions are illustrated by Figure 3-3.

3-20. VOLTAGE MEASUREMENT

3-21. Both the ac and dc voltage ranges use an over-voltage-protected, 10 MΩ input divider as shown in View A. Under normal conditions, assuming a dc input level on the porper range, the divider output is a 0.2 to +0.2V dc signal, and is an exact (power-of-10) ratio of the input signal. If the VAC function is selected, the divider output is ac coupled to an active full-wave rectifier whose dc output is calibrated to equal the rms level of the ac inputs. The conditioned signal for the selected function (V ac or V dc) is then passed through a filter before being presented to the a d converter as the unknown input.

3-22. CURRENT MEASUREMENT

3-23. Current measurements are made using a fuse protected, switchable, four-terminal current shunt (0.1Ω, 1Ω, 10Ω, or 100Ω) to perform the current-to-voltage conversion required by the a d converter. See View B. The voltage (I R) drops produced across the selected shunt may be either ac or dc depending upon the selected function, mA AC or mA DC. If the input current is dc and the dc function is selected, the I R drop is passed through a low-pass filter, and presented as the unknown input ot the a, d converter. However, if the input current is ac and the AC function is selected, the I R drop is rectified by the ac converter before going to the low-pass filter. In either event the a d converter receives a dc input voltage proportional to the current passing through the selected shunt.

3-24. RESISTANCE MEASUREMENTS

3-25. Resistance measurements are made using a ratio technique as shown in View C. When the Ω function is selected, a simple series circuit is formed by the internal reference voltage, a reference resistor from the voltage divider (selected by range switches),and the external unknown resistor. The ratio of the two resistors is equal to the ratio of their respective voltage drops. Therefore, since the value of one resistor is known, the value of the second can be determined by using the voltage drop across the known resistor as a reference. This determination is made directly by the a/d converter.

3-26. Overall operation of the a/d converter during a resistance measurement is basically as described earlier in this section, with one exception. The reference voltage present during a voltage measurement is replaced by the voltage drop across the reference resistor. This allows the voltage across the unknown resistor to be read during the integrate period,and compared against the reference resistor during the read period. As before, the length of the read period is a direct indication of the value of the unknown.

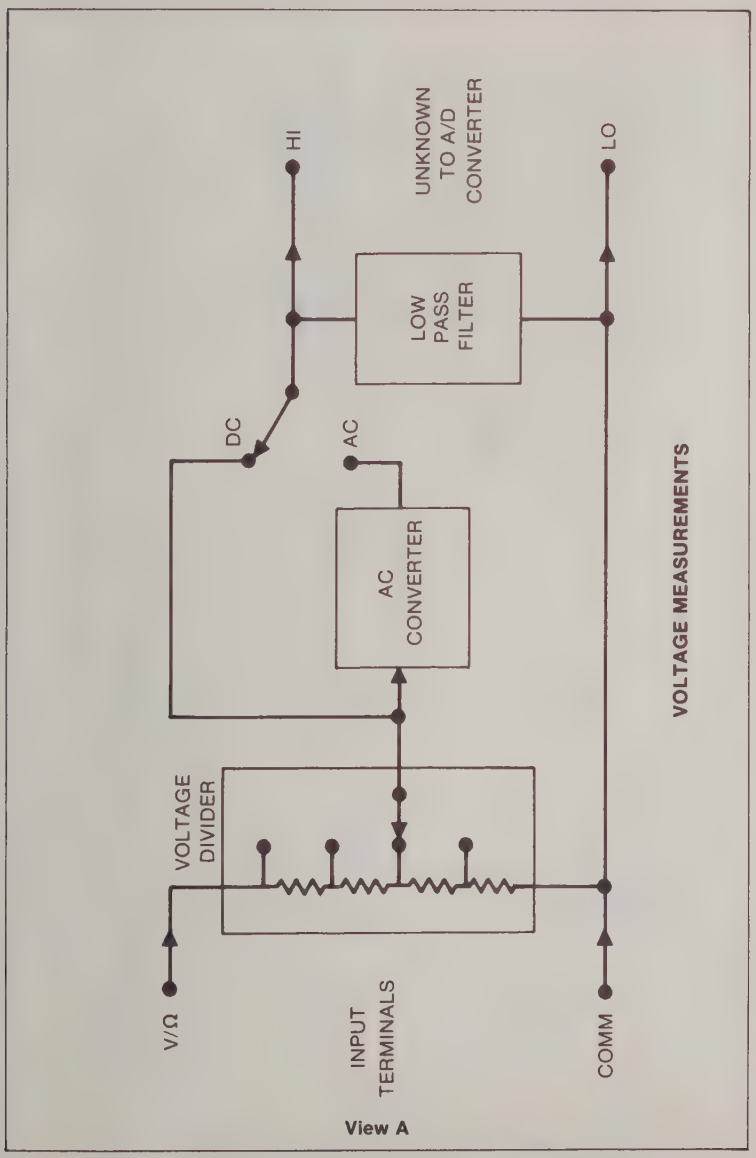


Figure 3-3. Input Signal Conditioners

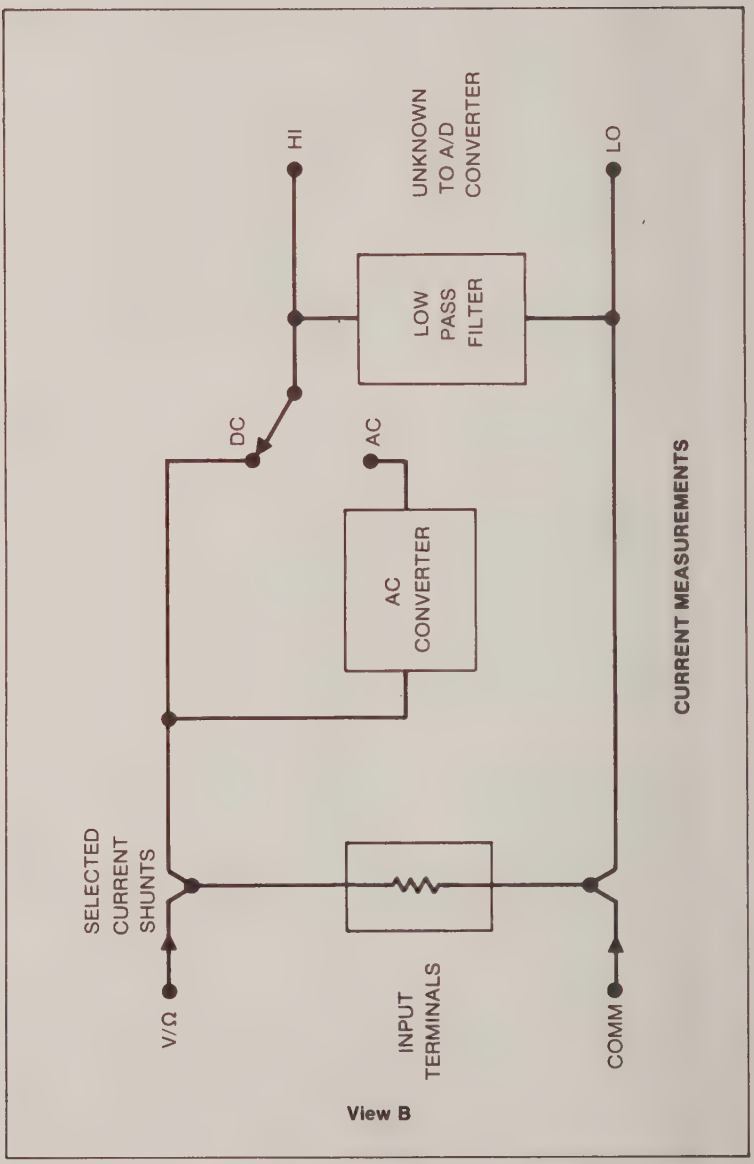


Figure 3-3. Input Signal Conditioners (cont)

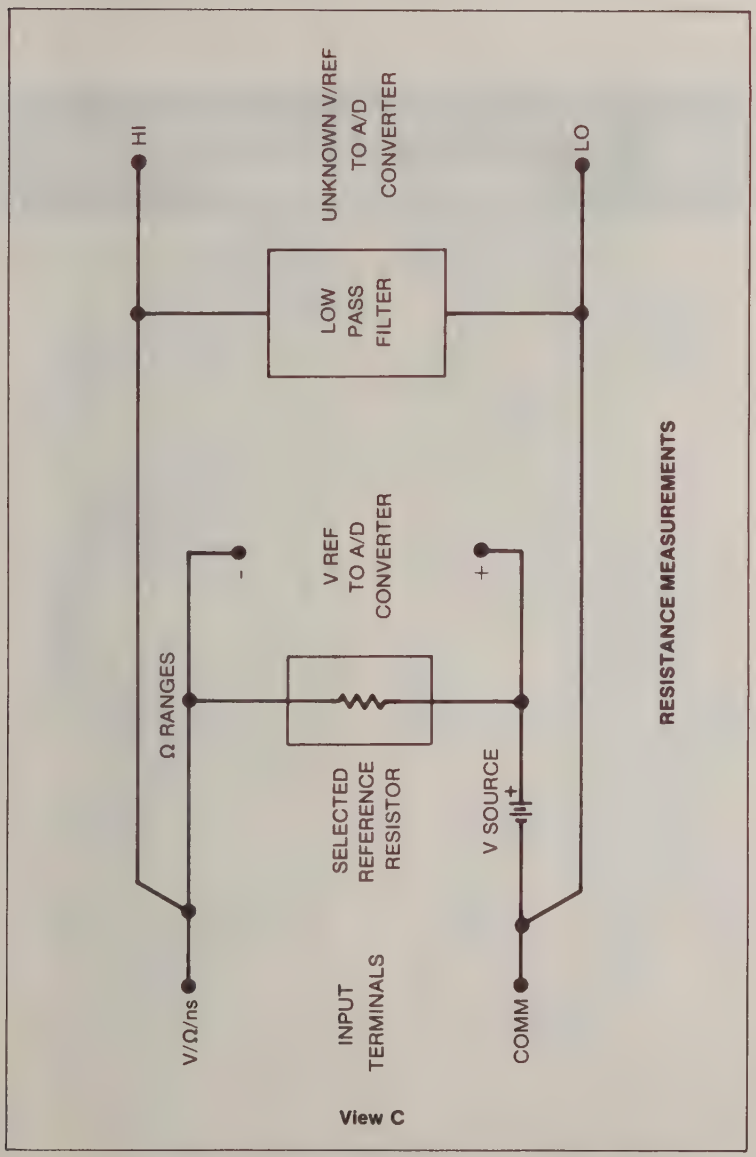
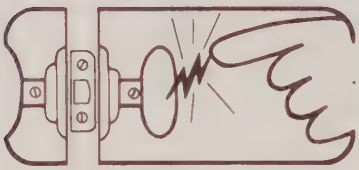


Figure 3-3. Input Signal Conditioners (cont)

static awareness

A Message From

John Fluke Mfg. Co., Inc.

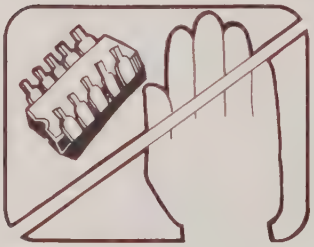


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

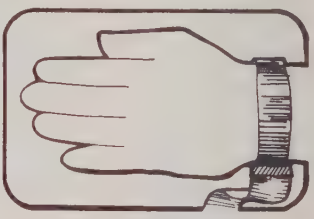
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S S) devices are identified in the Fluke technical manual parts list with the symbol "Ⓢ".

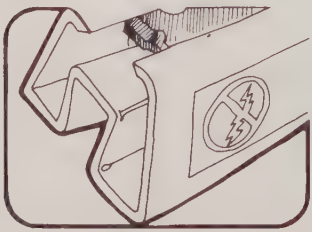
The following practices should be followed to minimize damage to S.S. devices.



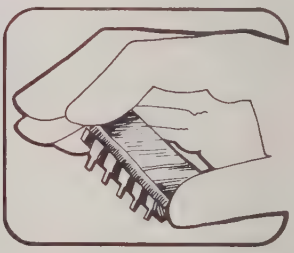
1. MINIMIZE HANDLING



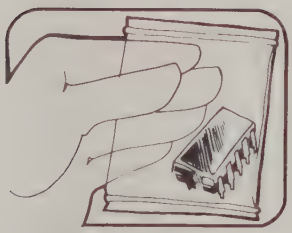
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



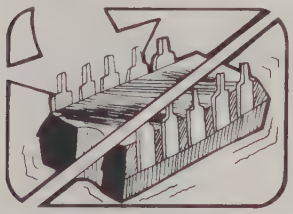
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



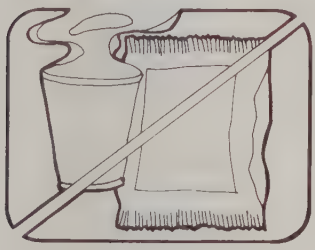
4. HANDLE S.S. DEVICES BY THE BODY



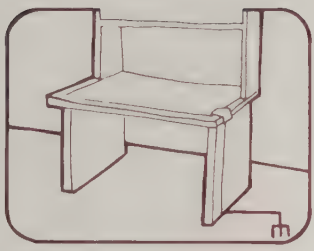
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED

Anti-static bags, for storing S S devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

Section 4
Maintenance

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model D 800. This includes service information, general maintenance, performance test, calibration and troubleshooting. The performance test is recommended as an acceptance test when the unit is first received, and later as a preventive maintenance tool to verify proper instrument operation. A 1-year calibration cycle is recommended to maintain the specifications given in Section 1 of this manual. The test equipment required for both the performance test and calibration is listed in Table 4-1. If the recommended equipment is not available, instruments having equivalent specifications may be used.

4-3. SERVICE INFORMATION

4-4. The D 800 is warranted for a period of 1-year upon delivery to the original purchaser. Conditions of the warranty are given at the rear of this manual.

4-5. Malfunctions that occur within the limits of the warranty will be corrected at no charge. Simply mail the instrument (postpaid) to your nearest authorized (in-warranty) Fluke Technical Service Center. A complete list of service centers are provided at the rear of this manual. Dated proof-of-purchase will be required for all in-warranty repairs.

4-6. Factory authorized service centers are also available for calibration and/or repair of instruments that are beyond their warranty period. Contact your nearest authorized Fluke Technical Service Center for a cost quotation. Ship the instrument and remittance using the instructions given at the end of this manual.

Table 4-1. List of Recommended Test Equipment

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
PREFERRED		
DMM Calibrator	John Fluke 5100A family	John Fluke Models 5100A, 5101A, 5102A
ALTERNATE		
AC Calibrator	Voltage Range: 0 to 750V ac Frequency Range: 100 to 450 Hz: ±0.25% Voltage Accuracy: 100 to 450 Hz: ±0.1%	John Fluke Models 5200A and 5215A
DC Calibrator	Voltage Range: 0 to 1000V dc Accuracy: ±0.025%	John Fluke Model 343A
DC Current Calibrator	Current Range: 2 mA to 2A Accuracy: ±0.2%	John Fluke Model 382A
Resistor Decade or Individual Resistors	Resistance Values: 190Ω, 1.9 kΩ, 19 kΩ, 190 kΩ, 1.9 MΩ, and 10 MΩ Accuracy: ±0.025% Power Rating: ⩾1/8 watt	ESI Model DB62

4-7. GENERAL INFORMATION

4-8. Access Information

NOTE

To avoid contaminating the pcb with oil from the fingers, handle it by the edges or wear gloves. If the pcb does become contaminated, refer to the cleaning procedure given later in this section.

4-9. BACKUP FUSE (F2) AND CALIBRATION ACCESS

4-10. Use the following procedure to access the D800 calibration adjustments.

1. Set the power switch to OFF.
2. Disconnect test leads and battery eliminator, if attached.
3. Remove battery cover and battery from compartment.
4. Remove the three phillips-head screws from the bottom of the case.

5. Turn the instrument face-up and grasp the top cover at both sides of the input connectors. Then, pull the top cover from the unit.

6. Backup Fuse (F2), and all adjustments necessary to complete the calibration procedure are now accessible (see Figure 4-1).

4-11. COMPONENT/PCB ACCESS

4-12. Use the following procedure to remove the Main PCB Assembly from the case:

1. Complete the calibration access procedure.

2. Remove the screw from shield.

3. Using your index finger, lift the lower right-hand corner of the pcb. When the pcb is freed, pull it to the right until it clears the shelf under the buttons, and then lift up.

4. To reassemble, logically reverse this procedure.

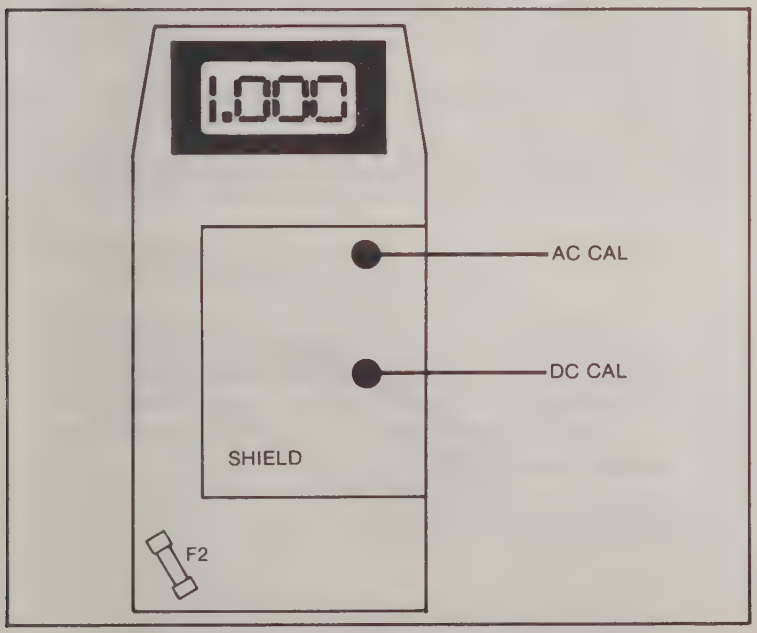


Figure 4-1. Calibration Adjustment Locations

NOTE

When installing pcb, route battery-clip wires behind the post on the left-hand side of bottom case, and thread battery-clip through the battery-cover opening. Also make sure that the removable plastic lip that resides beneath the range switch pushbuttons is properly installed in the bottom case. Green power switch cap should also be mounted on the power switch.

4-13. DISPLAY ACCESS

4-14. Refer to Figure 4-2 and the following procedure to remove/replace the LCD assembly.

1. Remove the Main PCB assembly using the PCB access procedure.

2. Place your thumbs on either side of the display lens and carefully push the lens out of the LCD bracket.

3. Turning LCD bracket upside down gently tap into your palm, LCD should fall out.

NOTE

When installing the LCD make certain that its flat surface is facing out and its connector pattern is on top of and makes contact with, the flexible layered connector.

4-15. LSI (U8) ACCESS

4-16. Use the following procedure to remove/replace the A/D Converter and Display Driver IC, U8.

1. Remove the pcb assembly using the component/pcb access procedure.

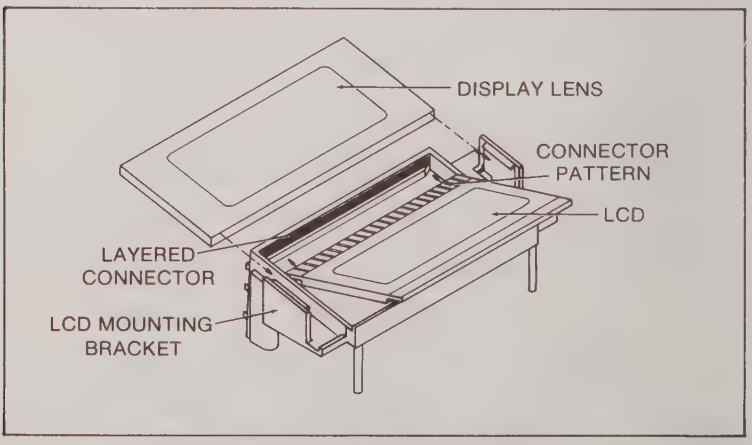


Figure 4-2. LCD Display Assembly

2. On the bottom of the pcb locate and remove the two phillips-head screws from the display assembly.

3. Lift the display assembly from the pcb to expose U8.

CAUTION

U8 is a MOS device and is subject to damage by static discharge. Observe the precautions given later in this section under troubleshoooting before attempting to remove or replace U8.

4. Use a screw driver or a reasonable substitute to rock (by prying up on each end of the IC) the IC out of it socket.

5. When installing U8 make sure all pins are lined up in the socket, and then carefully press it into place.

4-17. Cleaning

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. These solutions will react with the plastic materials used in the instrument.

CAUTION

Do not allow the liquid crystal display to get wet. Remove the Display Assembly before washing the pcb and do not install it until the pcb has been fully dried.

4-18. Clean the front panel and case with a mild solution of detergent and water. Clean dust from the circuit board with low pressure (20 psi) dry air. Contaminants can be removed from the circuit board with demineralized water and a soft brush (remove the Display Assembly before washing, and avoid getting excessive amounts of water on the switches). Dry with clean, dry air at low pressure, and then bake at 50 to 60°C (124-140°F) for 24 hours.

4-19. Battery/Backup Fuse Replacement

WARNING

BATTERY/FUSE REPLACEMENT SHOULD ONLY BE PERFORMED AFTER THE TEST LEADS HAVE BEEN REMOVED FROM THE INPUT JACKS, AND THE POWER SWITCH IS SET TO OFF. BACKUP FUSE REPLACEMENT PROCEDURE TO BE PERFORMED BY QUALIFIED SERVICE PERSONELL ONLY. USE ONLY THE RECOMMENDED REPLACEMENT TYPE.

4-20. Refer to Section 2 of this manual for battery and main fuse (F1) replacement procedure. Use the following procedure to replace the backup fuse (F2).

1. Complete the "Backup Fuse and Calibraiton Access Procedure" located earlier in this section.

2. Using a pointed tool such as a probe tip, pry the backup fuse from its holder

3. Replace the defective backup fuse with a 3A, 600V type BBS-3 only.

4-21. PERFORMANCE TEST

4-22. The performance test is used to compare the D 800 performance with the list of specifications given in Section 1 of this manual. It is recommended for incoming inspection, periodic maintenance, and to verify specifications. If the instrument fails any part of the test, calibration and/or repair is indicated.

4-23. Initial Procedure

4-24. Each of the individual procedures that comprise the performance test assumes that the following conditions exist.

1. the unit has been allowed to stabilize and will be tested at an ambient temperature of 23 ±5°C (73 ±9°F).

2. The fuses and battery have been checked and, if necessary, replaced.

3. The power switch has been set to ON.

4-25. Display Test

4-26. The following procedure is used to test the operation of all display digits and segments.

1. Select the Ω function and the 20 kΩ range. The display should be blanked with the exception of the overrange indicator (1) in the left hand column and a decimal point in the center of the display.

2. Connect a decade resistor between the V Ω and COMMON input terminals.

3. Set the decade resistor to 10 kΩ and verify a display of 10.00 ±3 digits.

4. Sequentially increase the resistance in 1.11 kΩ steps and verify the operation of each digit and its segments.

5. Disconnect the decade resistor at the input terminals, and select the 2000 kΩ range. A decimal point should not be displayed.

6. Sequentially select the 200, 20 and 2 kΩ range. The decimal point should appear in the tenths, hundredths, and thousandths position, respectively.

4-27. Resistance Test

4-28. The operation and accuracy of the resistance ranges are tested in the following procedure.

1. Connect the decade resistor between the V, Ω and COMMON input terminals.

2. Refer to Table 4-2, and select the range and input conditions specified in step 1. Verify that the display reading is within the limits shown.

3. Execute and verify steps 2 through 8 of Table 4-2, using the procedure described in step 2.

Table 4-2. Resistance Checks

STEP	RANGE	JOHN FLUKE 5100A/5101A/5102A		ESI MODEL DB62	
		INPUT RESISTANCE	DISPLAY READING	INPUT RESISTANCE	DISPLAY READING
1	200Ω	Short	00.0 to 00.2	Short	00.0 to 00.2
2	2 kΩ	Short	0.000 to 0.001	Short	0.000 to 0.001
3	200Ω	100Ω	99.4 to 100.6	190Ω	189.1 to 190.9
4	2 kΩ	1 kΩ	0.997 to 1.003	1.9 kΩ	1.895 to 1.905
5	20 kΩ	10 kΩ	9.97 to 10.03	19 kΩ	18.95 to 19.05
6	200 kΩ	100 kΩ	99.7 to 100.3	190 kΩ	189.5 to 190.5
7	2000 kΩ	1000 kΩ	997 to 1003	1900 kΩ	1895 to 1905
8	20 MΩ	10 MΩ	9.70 to 10.30	10 MΩ	9.80 to 10.20

4-29. DC Voltage Test

4-30. Use the following procedure to check the accuracy and overall operation of the dc voltage ranges.

WARNING

CONNECT THE GROUND/COMMON/LOW SIDE OF THE VOLTAGE CALIBRATOR TO COMMON ON THE D 800.

1. Set the dc voltage calibrator for a zero volt output.

2. Connect the calibrator output to the V, Ω and COMMON input terminals of the D 800 (calibrator ground/common/low to D 800 common).

3. With reference to Table 4-3, select the D 800 voltage range given in step 1, and set the calibrator output to the corresponding D 800 input voltage. Verify that the display reading is within the limit shown.

4. Execute and verify steps 2 through 7 of Table 4-3, using the procedure described in step 3.

4-31. AC Voltage Test

4-32. The ac voltage ranges are checked for accuracy and operation using the following procedure.

WARNING

CONNECT THE GROUND/COMMON/LOW SIDE OF THE AC CALIBRATOR TO COMMON ON THE MODEL D 800.

1. Set the ac calibrator for a zero volt ac output.

Table 4-3. DC Voltage Checks

STEP	VOLTAGE RANGE	INPUT VOLTAGE, DC	DISPLAY READING
1	200 mV	+190.0 mV	189.1 to 190.9
2	200 mV	-190.0 mV	-189.1 to -190.9
3	2V	0.0V	-.001 to .001
4	2V	+1.9V	1.891 to 1.909
5	20V	+19V	18.91 to 19.09
6	200V	+190V	189.1 to 190.9
7	1000V	+1000V	995 to 1005

2. Connect the calibrator output to the V/Ω and COMMON input terminals for the D 800 (calibrator ground/common/low to D 800 COMMON).

3. With reference to Table 4-4, select the D 800 voltage range given in step 1, and set the calibrator output to the corresponding D 800 input voltage and frequency. Verify that the display reading is within the limits shown.

4. Execute and verify steps 2 through 12 of Table 4-4, using the procedure described in step 3.

4-33. DC Current Test

4-34. The following procedure is used to check the operation and accuracy of the DC current ranges.

1. Set the output of the dc current source to zero mA.

2. Connect the output of the current source to the mA and COMMON input terminals on the D 800.

3. With reference to Table 4-5, select the D 800 current range indicated in step 1, and set the calibrator output to provide the corresponding D 800 input current. Verify that the display reading is within the limits shown.

4. Execute and verify steps 2 through 4 of Table 4-5, using the procedure described in step 3.

4-35. CALIBRATION

4-36. Under normal operating conditions, the D 800 should be calibrated once a year to maintain the specifications given in Section 1 of this manual. If instrument repairs have been made or if the unit fails the performance test, immediate calibration is indicated. Equipment required for calibration is given in Table 4-1. If the necessary equipment is not available, your nearest authorized Fluke Technical Service Center will be happy to help. A list of these service centers, as well as shipping information, is given at the back of this manual.

Table 4-4. AC Voltage Test

STEP	VOLTAGE RANGE	INPUT		DISPLAY READING
		VOLTAGE	FREQ.	
1	200 mV	Short	-	00.0 to 00.2
2	200 mV	190 mV	100 Hz	188.4 to 191.6
3	200 mV	19 mV	100 Hz	18.7 to 19.3
4	2V	1.9V	100 Hz	1.884 to 1.916
5	20V	19V	100 Hz	18.84 to 19.16
6	200V	190V	100 Hz	188.4 to 191.6
7	750V	750V	400 Hz	741 to 759

If the alternate test equipment listed in Table 4-1 is used, the Input Frequency in step 7 should be 100 Hz. All other factors of step 7 are the same.

Table 4-5. DC Current (mA) Checks

STEP	CURRENT RANGE	INPUT CURRENT, DC	DISPLAY READING
1	2 mA	+1.9 mA	1.880 to 1.920
2	20 mA	-19 mA	-18.80 to -19.20
3	200 mA	+190 mA	188.0 to 192.0
4	2000 mA	+1900 mA	1880 to 1920

4-37. Use the following procedure to calibrate the D 800.

NOTE

This procedure assumes an ambient temperature of 23 ±2° C (70 to 77° F) and a relative humidity of less than 80%. The temperature of the unit should be allowed to stabilize for at least 30 minutes before calibration begins.

1. Remove the top cover from the D 800 using the access procedure given earlier in this section.

2. Set the D 800 power switch to ON and select the 200 mV DC range.

3. Set the output of the dc calibrator to +190.0 mV and connect it to the D 800 input terminals; + to V/Ω, and - to COMMON.

4. Adjust the DC CAL pot (R6), as shown in Figure 4-1, for a display of 190.0 or 190.1. (Use a plastic adjustment tool or a common plastic screw driver for all ajustments.)

5. Disconnect the dc calibrator from the D 800 input terminals.

6. Select the 200 mV AC range on the D 800.

7. Set the output of the ac calibrator to 190 mV at 100 Hz, and connect it to the D 800 input terminals; V/Ω and COMMON.

8. Adjust the AC CAL pot (R4) for a display of 190.0 (an occasional flash of ±1 digit is acceptable).

9. Execute the performance test given earlier to ensure that all fixed range resistors and other non-adjustable components are operating within their specified limits.

4-38. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components contained in the D 800.

4-39. When troubleshooting or repairing the D 800 use the precautions listed on the Static Awareness sheet to prevent damage from static discharge. Never remove, install or other wise connect or disconnect components without first turning the D 800 power switch to OFF.

4-40. A troubleshooting guide for the D 800 is given in Table 4-6. To properly use the guide complete the performance test given earlier in this section and note any discrepancies. Then locate the heading of the procedure in question in the Test and Symptom column (Table 4-6). Under that heading isolate the symptom that approximates the observed malfunction. Possible causes are listed to the right of the selected symptom. Details necessary to isolate a particular cause can be derived from the theory of operation in Section 3 and the schematic diagram in Section 7.

Table 4-6. Troubleshooting Guide

TEST AND SYMPTOM	POSSIBLE CAUSE
INITIAL PROCEDURE	
BT is displayed when unit is turned on.	Low battery, Q2, U7, U8. (See also operating note for A81 accessory.)
Display blank.	Dead battery, power switch, VR2 shorted, U8.
DISPLAY TEST	
One or more segments will not light through entire test.	Display interconnect, display, or A/D Converter U8.
Decade inoperative or one or more segments always lit.	U8.

Table 4-6. Troubleshooting Guide (cont)

TEST AND SYMPTOM	POSSIBLE CAUSE
DISPLAY TEST (cont)	
Improper decimal point indication.	Range switches, U6, U7, or display. (Check signals at U7 to isolate.)
Minus sign improperly displayed.	U8.
Display lit but does not respond to changes in input.	Reference VR1, crystal Y1, A/D Converter U8.
RESISTANCE TEST	
Displayed reading is out of tolerance on at least one but not all ranges.	Range resistor U1.
Readings are noisy on all ranges.	Thermistor RT1.
Readings are out of tolerance on high ohms.	RV1, RV2, RV3, RV4 overheated from severe overload.
Residual reading with test leads open.	PCB is contaminated (see cleaning procedure, Section 4).
DC VOLTAGE TEST	
Display reading is out of tolerance on 200 mV range.	Out of calibration (DC), Vref (VR1) in error, U5, U8, S1.
Readings are out of tolerance on all ranges except 200 mV.	Range resistor U1, U2, U3.
AC VOLTAGE TEST	
Displayed reading is out of tolerance on 200 mV range.	Out of calibration (AC), AC converter defective.
Readings are out of tolerance on all ranges except 200 mV.	U1.
DC CURRENT TEST	
Input does not affect display.	Fuse F1 and/or F2 open, CR1, CR2.
Displayed reading is out of tolerance on one or more ranges.	If 2000 mA and 200 mA ranges are okay, U2 is defective. Otherwise U3 is defective.

Table 4-6. Troubleshooting Guide (cont)

TEST AND SYMPTOM	POSSIBLE CAUSE
CALIBRATION	
DC CAL pot at limit.	VR1, U5, or R6.
AC CAL pot at limit.	U4, CR5, CR6, R4, AR1, dc calibration.

Section 5
List of Replaceable Parts

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. A similar parts listing for each of the Options will be found in Section 6. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed by reference designation. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation.

2. Description of each part.

3. FLUKE Stock Number.

4. Federal Supply Code for Manufacturers. (See Table 5-6 for Code-to-Name list.)

5. Manufacturer's Part Number.

6. Total Quantity per assembly or component.

7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order

has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity
2. FLUKE Stock Number
3. Description
4. Reference Designation
5. Printed Circuit Board Part Number
6. Instrument Model and Serial Number

CAUTION

Indicated devices are subject to damage by static discharge.

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
	D 800, FINAL ASSEMBLY FIGURE 5-1						
A1Ⓟ	PCB ASSEMBLY FIGURE 5-2	ORDER	ONLY	REPLACEABLE PARTS	1		
A2	CASE ASSEMBLY SEE FIGURE 5-1	606772	89536	606772	1		
BT1	BATTERY, 9-VOLT	446823	89536	446823	1		1
H1	SCREW, PHP, 2-56 X 3/16	272906	73734	19001	1		
H2	SCREW, PHP, THREAD FORMING	447953	89536	447953	3		
MP11	TEST LEADS (NOT SHOWN)	516666	89536	516666	1		
MP12	BUTTON POWER SWITCH	456491	89536	456491	1		
TM1	MANUAL, INSTRUCTION (NOT SHOWN)	583708	89536	583708	1		
	CARD, OPERATOR'S GUIDE (NOT SHOWN)	583716	89536	583716	1		
	RECOMMENDED SPARE PARTS KIT (D800)	608927	89536	608927	AR		

1 INSTALLED BY CUSTOMER.
SEE SECTION 2.

Table 5-1. D 800 Final Assembly

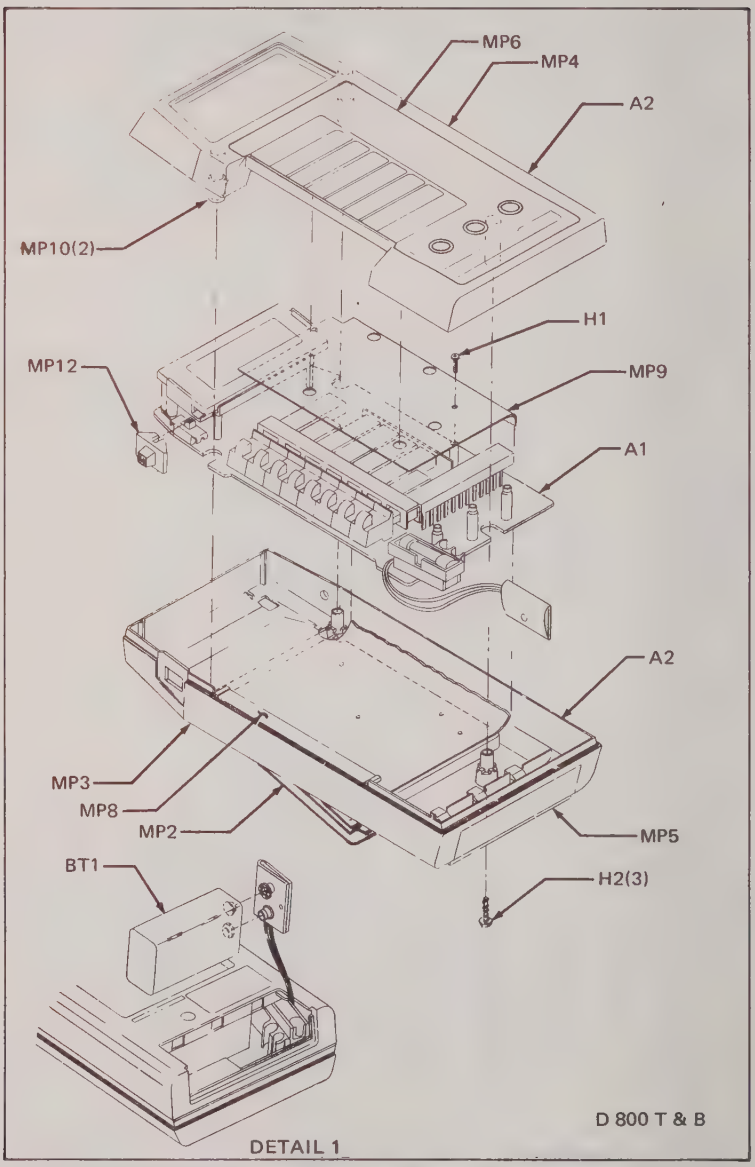


Figure 5-1. D 800 Final Assembly and A2 Case Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
A1Ⓐ	D800 PCB ASSEMBLY FIGURE 5-2				REF		1
AR1	IC, DUAL, OP AMP	418566	89536	418566	1	1	
C2	CAP, MYLAR, 0.022 UF +/-10%, 1000V	448183	89536	448183	1		
C3	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	2		
C5	CAP, MYLAR, 0.1 UF +/-10%, 100V	393439	73445	C280MAH/A100K	1		
C6	CAP, PLLY PROPL. 0.047 UF +/-10%, 100V	446773	89536	446773	2		
C7	CAP, CER, 500 PF +/-10%, 500V	105692	71590	2DDH60N501K	1		
C8	CAP, POLY PROPL. 0.047 UF +/-10%, 100V	446773	89536	446773	REF		
C9	CAP, POLY PROPL. 0.1 UF +/-10%, 100V	446781	89536	446781	1		
C10	CAP, MYLAR 0.22 UF +/-10%, 100V	436113	73445	C280MAH/A220K	1		
C11	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
CR1	DIODE, SI, RECTIFIER	347559	05277	1N5400	2	1	
CR2	DIODE, SI, RECTIFIER	347559	05277	1N5400	REF		
CR3	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	4	1	
CR4	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR5	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR6	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
F1	FUSE, 2 AMP/250V				1	5	
	AMERICAN SIZE (1" X 1/4") TYPE AGX2	376582	71400	AGX2			
F2	FUSE, 3 AMP/600V, TYPE BBS-3	475004	71400	BBS-3	1	5	
H1	SCREW, THREAD-FORMING, 3/8 HI-LO TYPE	448456	89536	448456	2		
J4	CONNECTOR, DC POWER	423897	89536	423897	1		
J5	CONTACT ASSEMBLY	535278	89536	535278	1		

Table 5-2. A1 Main PCB Assembly

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
MP1	BRACKET, LCD (U9), MOUNTING	531657	89536	531657	1		
MP2	CONNECTOR, LAYERED	520858	89536	520858	1		
MP3	DISPLAY, LENS, PLASTIC	606848	89536	606848	1		
MP4	BRACKET, LCD PLATE	531665	89536	531665	2		
MP5	PUSHBUTTON, RANGE (DARK AMBER)				6		
	IF SWITCH ASSEMBLY IS WHITE, ORDER	606885	89536	606885			
	IF SWITCH ASSEMBLY IS BLUE, ORDER	606871	89536	606871			
MP6	PUSHBUTTON, FUNCTION (DARK PEWTER)				2		
	IF SWITCH ASSEMBLY IS WHITE, ORDER	606863	89536	606863			
	IF SWITCH ASSEMBLY IS BLUE, ORDER	606889	89536	606889			
MP7	FUSE CLIP	534925	89536	534925	1		
MP8	FUSE SPRING (NOT SHOWN)	535211	89536	535211	1		
MP9	FUSE CLIP	535203	89536	535203	1		
Q1	XSTR, SI, NPN	483859	89536	483859	2	1	
Q2	XSTR, SI, NPN	483859	89536	483859 0.70	REF		
R1	RES, COMP, 100K +/-10%, 1W	109397	01121	GB1041	1		
R2*	RES, WW, 1K +/-10%, 2W	474080	89536	474080 2.7*	1		
R3	RES, COMP, 2.2M +/-5%, 1/4W	198390	01121	CB2255	1		
R4	RES, VAR, 300 +/-10%	447722	89536	447722	1	1	
R5	RES, COMP, 1M +/-10%, 1W	109793	01121	GB1051	1		
R6	RES, VAR, 500 +/-10%	447730	89536	447730	1	1	
R8	RES, COMP, 220K +/-5%, 1/4W	160937	01121	C92245	1		
R9	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	1		
R10	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	1		
RT1	THERMISTOR, 1K +/-40%	446849	89536	446849	1		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
RV1	VARISTOR, 430V +/-10%	447672	09214	V150LAX827	4	1	
RV2	VARISTOR, 430V +/-10%	447672	09214	V150LAX827	REF		
RV3	VARISTOR, 430V +/-10%	447672	09214	V150LAX827	REF		
RV4	VARISTOR, 430V +/-10%	447672	09214	V150LAX827	REF		
S1-S8	SWITCH ASSEMBLY, PUSHBUTTON	453647	89536	453647	1	1	
S9	SWITCH, SLIDE, SPDT	453365	89536	453365	1	1	
U1	RESISTOR NETWORK (INPUT DIVIDER)	424085	89536	424085	1	1	
U2	RESISTOR NETWORK	447706	89536	447706	1	1	
U3	RESISTOR NETWORK	435727	89536	435727	1	1	
U4	RESISTOR NETWORK	447698	89536	447698	1	1	
U5	RESISTOR NETWORK	447680	89536	447680	1	1	
U6	RESISTOR NETWORK	447714	89536	447714	1	1	
U7⊗	IC, MOS, QUAD, 2-INPUT OR GATE	355222	02735	CD4030AE	1	1	
U8⊗	IC, C-MOS, LCD INTERFACING (40 PIN)	429100	89536	429100	1	1	
U9	IC, LIQUID CRYSTAL DISPLAY, 3 1/2 DIGITS	504324	89536	504324	1	1	
VR1	REFERENCE, LOW VOLTAGE, 1.22V	452771	89536	452771	1		
VR2	DIODE, ZENER, 12V	113456	07910	1N963A	1		
XF2	FUSE CASE	540716	89536	540716	1		
XU8	SOCKET, IC, 40-PIN	429282	89536	429282	1		
Y1	CRYSTAL, 3.2 MHZ	460550	89536	460550	1		

*R2 IS A FUSABLE RESISTOR. USE EXACT REPLACEMENT TO INSURE SAFETY.

1 ASSEMBLY IS NOT PROCURABLE AT THIS LEVEL.

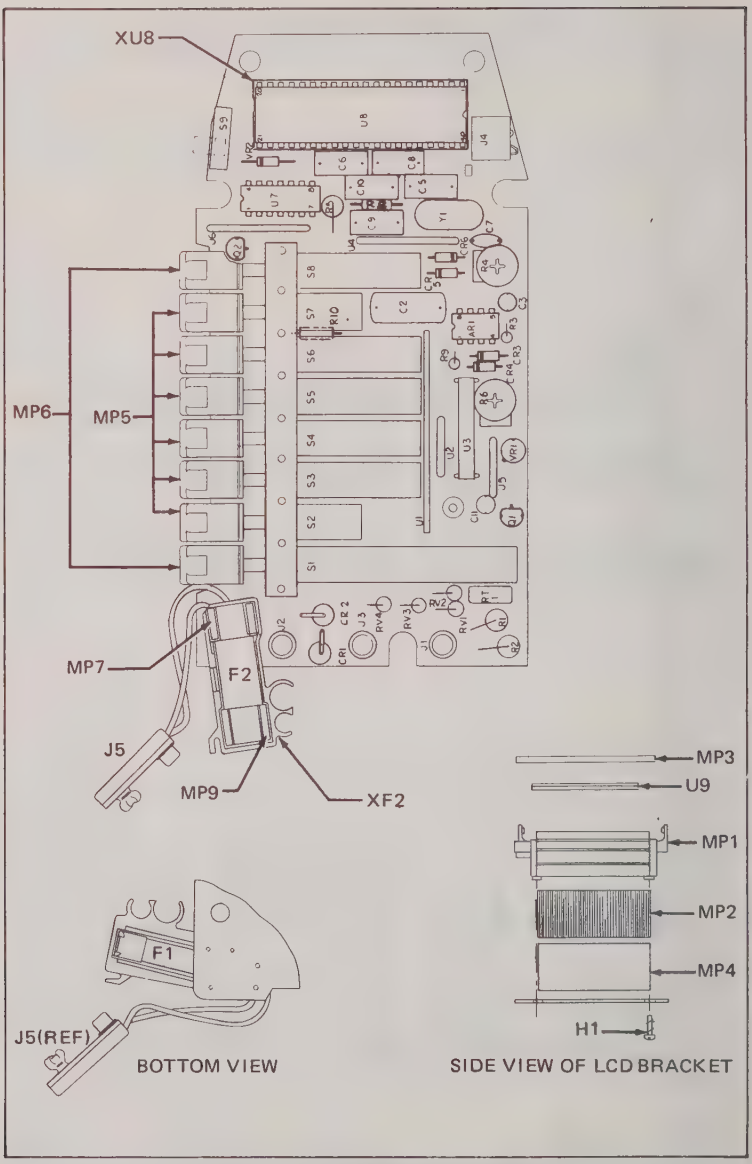


Figure 5-2. A1 Main PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
A2	D 800 CASE ASSEMBLY SEE FIGURE 5-1	606772	89536	606772	REF		
MP1	SHOCK ABSORBER (NOT SHOWN)	428441	89536	428441	1		
MP2	BAIL, TILT	606921	89536	606921	1		
MP3	CASE, PLASTIC, BOTTOM	606814	89536	606814	1		
MP4	CASE, PLASTIC, TOP	606897	89536	606897	1		
MP5	COVER, BATTERY	606822	89536	606822	1		
MP6	DECAL, FRONT PANEL	585729	89536	585729	1		
MP7	DECAL, WARNING (NOT SHOWN)	585968	89536	585968	1		
MP8	FLANGE, SWITCH	606830	89536	606830	1		
MP9	SHIELD	453845	89536	453845	1		
MP10	SPACER, CASE	458588	89536	458588	2		

Table 5-3. A2 Case Assembly

Table 5-4. Fluke Technical Service Centers-U.S. and Canada

UNITED STATES

CA, Burbank
Fluke Technical Center
2020 N. Lincoln Street
Burbank, CA 91504
(213) 849-4641

CA, Santa Clara
Fluke Technical Center
2300 Walsh Avenue
Santa Clara, CA 95050
(408) 985-1200

CO, Denver
Fluke Technical Center
1980 S. Quebec Street, Unit 4
Denver, CO 80231
(303) 750-1228

FL, Orlando
Fluke Technical Center
940 N. Fern Creek Avenue
Orlando, FL 32803
(305) 896-2296

IL, Rolling Meadows
Fluke Technical Center
1400 Hicks Road
Rolling Meadows, IL 60008
(312) 398-5800

MA, Waltham
Fluke Technical Center
244 Second Avenue
Waltham, MA 02154
(617) 890-1604

MD, Rockville
Fluke Technical Center
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1576

MN, Apple Valley
Fluke Technical Center
7373 West 147th Street, Suite 196
Apple Valley, MN 55124
(612) 432-9400

NC, Greensboro
Fluke Technical Center
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

NJ, Paramus
Fluke Technical Center
West 75th Century Road
Paramus, NJ 07652
(210) 262-9550

TX, Dallas
Fluke Technical Center
14400 Midway Road
Dallas, TX 75240
(214) 233-9945

WA, Mountlake Terrace
John Fluke Mfg. Co., Inc.
21707 66th Avenue W., Suite 1
Mountlake Terrace, WA 98043
(206) 774-2206

CANADA

ALB, Calgary
Allan Crawford Assoc., Ltd.
1935 30th Avenue N.E. #14
Calgary, ALB T2E 6Z5
(403) 230-1341

ONT, Mississauga
Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, ONT L4V 1J5
(416) 678-1500

QUE, St. Laurent
Allan Crawford Assoc., Ltd.
7018 Cote de Liesse
St. Laurent, QUE H4T 1E7
(514) 731-8564

Table 5-5. Fluke Technical Service Centers-International

ARGENTINA
Fluke Latin American
Service Headquarters
Virrey del Pino 4071
Buenos Aries, Argentina
Tel: 523185

AUSTRALIA
Elmeasco Instrument Pty Ltd.
P.O. Box 30
Concord, N.S.W.
Australia 2137
Tel: (02) 736-2888

AUSTRIA
Walter Rekirsch
Elektronische Gerate GmbH & Co.
Vertriebs-KG.
Liechtensteinstrasse 97/6
A-1090 Vienna, Austria
Tel: 09-43-222-347646

BELGIUM
Fluke (Belgium)S.A./N.V.
6, Rue de Geneve
1140 Brussels, Belgium
Tel: 09-32-2-2164090

BRAZIL
Arotec S.A.
Industria e Comercio
Av. Pacaembu 811
01234 Sao Paulo S.P., Brazil
Tel: 826-2266

CHILE
Intronica Chile Ltda.
Casilla 16228
Santiago 9, Chile
Tel: 44940

COLOMBIA
Coasin Ltda.
Carrera 13, # 37-37, Of. 407
Ap. Aero 29583
Bogota DE, Colombia
Tel: 285-0230

DENMARK
Tage Olsen A/S
Ballerup Byvej 222
DK-2750 Ballerup
Denmark
Tel: (01) 2-65 81 11

ECUADOR
Proteco Coasin Cia., Ltda.
Edificia "Jerico"
Ave. 12 de Octubre #2285y
Ave, Orellana (Planta Baja)
Quito, Ecuador
Tel: 526759

EGYPT
Lotus Engineering Organisation
P.O. Box 1252
Cairo, Egypt
Tel: 71617

FINLAND
Oy Findip AB
Teollisuustie 7
02700 Kauniainen
Finland
Tel: 09-358-0-502255

FRANCE
M.B. Electronique S.A.
Rue Fourny
ZAC de BUC
B.P. #31
78530 BUC, France
Tel: 09-33-1-9568131

GREECE
Hellenic Scientific
Representations Ltd.
11, Vrassida Street
Athens 615, Greece
Tel: 09-30-1-711140

HONG KONG
Gilman Industrial Bldg., 9F
107-109 Wai Yip Street
Kwun Tong
Kowloon, Hong Kong
Tel: 3-427144

INDIA
Hinditron Services Pvt. Ltd.
"Hinditron House"
412 Raj Mahal Vilas Extension
Bangalore 560 006, India
Tel: 33139

Hinditron Services Pvt. Ltd.
69 A.L. Jagmohandas Marg
Bombay 400 006, India
Tel: 365344

Table 5-5. Fluke Technical Service Centers-International (cont)

INDONESIA
P.T. Dwi Tunggal Jaya Sakti
Sangga Buana Bldg., 1st Floor
J1. Senen Raya 44, P.O. Box 4435
Jakarta, Indonesia
Tel: 376608

IRAN
Irantronics Company Ltd.
20 Salm Road
Roosevelt Avenue
Tehran, Iran
Tel: 828294/831564

ISRAEL
R.D.T. Electronics Engineering Ltd.
P.O. Box 75
46, Sokolov Street
Ramat Hasharon 47235
Israel
Tel: 09-972-3-483211

ITALY
Sistrel S.p.A.
Via Timavo 66
20099 Sesto S. Giovanni (Milan)
Italy
Tel: 09-39-2-2476693

Sistrel S.P.A.
Via Guiseppe Armellini #37
00143 Rome, Italy
Tel: 09-39-6-5915551

JAPAN
John Fluke Mfg. Co., Inc.
Japan Branch
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel: (045) 473-5425

KOREA
Electro-Science Korea Co.
C.P.O. Box 8446
Room 1201 Bowon Bldg.
490 Chongro - 5 Ka
Chongro-ku
Seoul, Korea
Tel: 261-7702

MALASIA
O'Connor's (Malaysia) SDN. BHD.
P.O. Box 91
Petaling Jaya, Selangor
West Malaysia
Tel: 51563

MEXICO
C.J. Christensen S.A. De C.V.
Melchor Ocampo 150-8
Mexico 4 D.F., Mexico
Tel: (905) 535-2258

NETHERLANDS
Fluke (Nederland) B.V.
P.O. Box 5053
5004 EB Tilburg
The Netherlands
Tel: (013) 673973

NEW ZEALAND
W & K McLean Ltd.
P.O. Box 18065
Glen Innes
Auchland, New Zealand
Tel: 587-037

NORWAY
Morgenstierne & Co. A/A
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: 09-47-2-356110

PAKISTAN
Pak International Operations
505 Mohammadi House
1.1. Chundrigar Road
Katrachi-2 Pakistan
Tel: 221127/239052

PERU
Importaciones Y Representaciones
Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru
Tel: 288650

PORTUGAL
Equipamentos de Laboratorio, Ltda
P.O. Box 1100
Lisbon 1002, Portugal
Tel: 09-351-1-578936/547512

Table 5-5. Fluke Technical Service Centers-International (cont)

REPUBLIC OF SINGAPORE
Rank O'Connor's (PTE) Ltd.
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: 637944

REPUBLIC OF SOUTH AFRICA
Fluke S.A. (Pty) Ltd.
P.O. Box 39797
Bramley 2018
Republic of South Africa
Tel: (011) 786-3170

SPAIN
Hispano Electronica S.A.
Apartado de Correos 48
Alcorcon (Madrid)
Spain
Tel: 09-3416194108

SWEDEN
Teleinstrument AB
P.O. Box 490
S-162 Vallingby 4
Sweden
Tel: 09-46-8-380370

SWITZERLAND
Traco Electronic AG
Jenatschstrasse 1
8002 Zurich
Switzerland
Tel: 09-41-1-2010711

TAIWAN
CCT Associates, Inc.
P.O. Box 24209
Taipei, Taiwan
Republic of China
Tel: (02) 391-6894/393-5760

THAILAND
Dynamic Supply Engineering R.O.P.
56 Ekamai, Sukhumvit 63
Bangkok-11, Thailand
Tel: 914434/928532

TURKEY
Erkman Electronik Aletler
Ticaret Anonim Sirketi
Necatiby Cad 92/3
Karakoy, Istanbul, Turkey
Tel: 09-44-1-5461

UNITED KINGDOM
Fluke International Corp. - UK
Colonial Way
Watford, Herts. WD24TT
United Kingdom
Tel: 09-4492340511

URUGUAY
Coasin Uruguaya S.R.L.
Edifico Ciudadela
Sarandi 690 D. Esc. 109
Casilla de Correos 1400
Correo Central
Montevideo, Uruguay
Tel: 917978

VENEZUELA
Coasin C.A.
Apdo. Postal 50939
Sabana Grande # 1
Caracas 105, Venezuela
Tel: 782-9109

WEST GERMANY
Fluke (Deutschland) GmbH
Krausstrasse 32
8045 Ismaning
West Germany
Tel: (089) 96251

Customers in the following countries: Bulgaria, Czechoslovakia, Hungary, Poland, Romania, U.S.S.R., and Yugoslavia, contact: Amtest Associates Ltd., P.O. Box 55, Addlestone, Surrey, KT 15 1DU, England, Tel. (0932) 52121

Table 5-6. Federal Supply Codes for Manufacturers

01121 Allen-Bradley Co. Milwaukee, Wisconsin	09214 G.E. Co. Semiconductor Products Dept. Power Semiconductor Products OPN Sec Auburn, New York	72982 Erie Tech. Products Inc. Erie, Pennsylvania
02735 RCA - Corp - Solid State Div. Sommerville, New Jersey		73445 Amperex Electronic Corp. Hicksville, LI, New York
04713 Motorola Inc. Semiconductor Products Phoenix, Arizona	56289 Sprague Electric Co. North Adams, Massachusetts	80031 Electro-Midland Corp., Mepco Div A North American Phillips Co. Morristown, New Jersey
05277 Westinghouse Electric Corp. Semiconductor Div. Youngwood, Pennsylvania	71400 Bussmann Mfg Div. of McGraw-Edison Co. St. Louis, Missouri	89536 Fluke, John Mfg. Co., Inc. Seattle, Washington
07910 Teledyne Semiconductor Formerly Continental Device Hawthorne, California	71590 Centrelab Electronics Div. of Globe Union Inc. Milwaukee, Wisconsin	91506 Augat Inc. Attleboro, Massachusetts

Section 6
Options and Accessories

6-1. INTRODUCTION

6-2. This section of the manual contains information concerning the accessories available for use with the Model D 800 Digital Multimeter (there are not options available at this time). Each accessory, as shown in Figure 6-1, is described in general terms under a separate major heading containing the accessory model number. The depth of detail is intended to give the prospective user and adequate first acquaintance with the features and capabilities of each accessory. Additional information, when necessary, is supplied with the accessory.

6-3. DELUXE CARRYING CASE (C90)

6-4. The C90 Deluxe Carrying Case is a pliable, vinyl, zipper-closed pouch that provides in-field-transport protection for the D 800, as well as convenient storage locations for test leads, operator's guide and other small accessories. A finger- or belt-loop is included on the case as a carrying convenience.

6-5. TEMPERATURE PROBES (80T-150C and 80T-150F)

6-6. Introduction

6-7. The 80T-150 Temperature Probes convert the instrument into a direct-reading (1 mV dc/°) °C (80T-150C) or °F (80T-150F) thermometer. It is ideally suited for surface, ambient and liquid measurement, and lends itself easily to a wide range of design, troubleshooting and evaluation applications. A rugged, fast-responding probe-tip with a 350V dc standoff makes the 80T-150 one of the most versatile and easy-to-use temperature probes available.

6-8. Specifications

Range (°C/°F) (field selectable by internal jumpers): -50°C to +150°C or -58°F to 302°F.
Accuracy: ±1°C (1.8°F) from 0°C to 100°C, decreasing linearly to ±3°C (5.4°F) at -50°C and +150°C.
Resolution: 0.1°C on 200 mV range.
Voltage Standoff: 350V dc or peak ac.
Power: Internal disposable battery; 1,000 hours of continuous use.

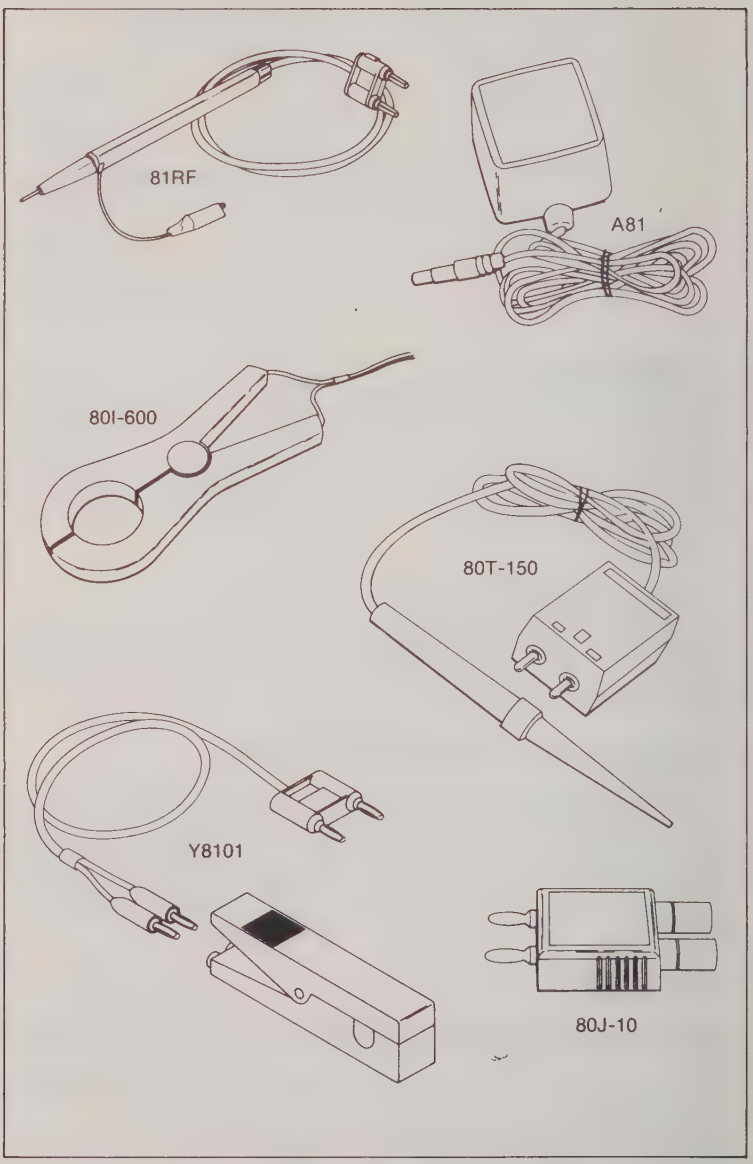


Figure 6-1. Model D 800 Accessories

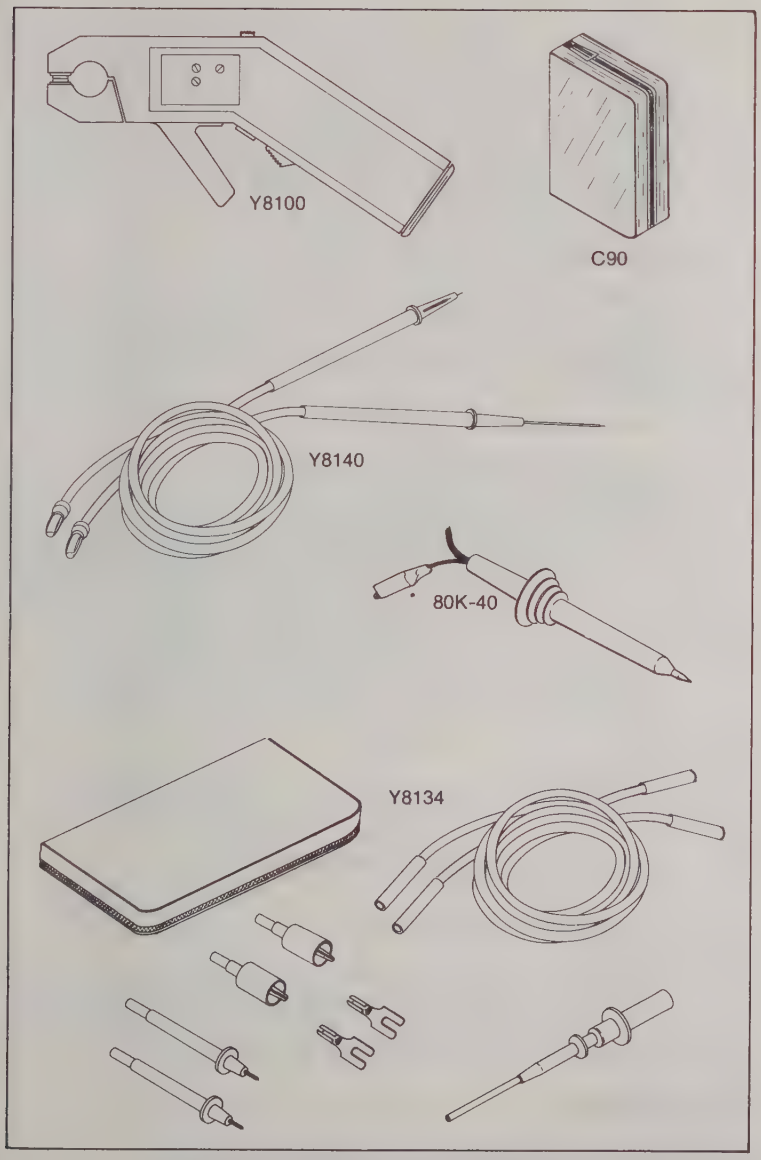


Figure 6-1. Model D 800 Accessories (cont)

6-9. CURRENT TRANSFORMER (80I-600)

6-10. Introduction

6-11. The Model 80I-600 extends the maximum 2A ac current measuring capability of the instrument up to a maximum of 600 amps. A clamp-on transformer designed into the probe allows measurements to be made without breaking the circuit under test. In use, the current carrying conductor being measured serves as the tranformer's primary, while the 80I-600 serves as the secondary. Because of a high efficiency, quadrature type of winding, wire size and location of the conductor within the transformer jaws do not affect accuracy of the current measurement.

6-12. Specifications

Range: 1 to 600A ac.
Accuracy: ±3%.
Frequency Response: 30 Hz to 1 kHz, 10 kHz typical.
Division Ratio: 1000:1.
Insulation: 5 kV.
Maximum Conductor Size: 2-inch diameter.

6-13. HIGH VOLTAGE PROBE (80K-40)

6-14. Introduction

6-15. The Model 80K-40 extends the voltage measurement capability of the instrument up to 40 kV. Internally, the probe contains a special 1000:1 resistive divider. Metal-film resistor with matched temperature coefficients comprise the divider, and provide the probe with its excellent accuracy and stability characteristics. Also, an unusually high input impedance (1000 MΩ) minimizes circuit loading, and thereby contributes to measurement accuracy.

6-16. Specifications

Voltage Range: 1 kV to 40 kV dc or peak ac, 28 kV rms ac.
Input Resistance: 1000 MΩ.
Division Ratio: 1000:1.
Accuracy DC overall Accuracy: 20 kV to 30 kV ±2% (calibrated at 25 kV).
Upper Limit: Changes linearly from 2% at 30 kV to 4% at 40 kV.
Lower Limit: Changes linearly from 2% at 20 kV to 4% at 1 kV.
Accuracy AC (Overall): ±5% at 60 Hz.

6-17. HIGH FREQUENCY PROBE (81RF)

6-18. Introduction

6-19. The 81RF Probe extends the frequency range of the instrument voltage measurements capability to include 100 kHz to 100 MHz inputs from 0.25 to 30V rms. It operates in conjunction with the instruments dc voltage ranges, and provides a dc output that is calibrated to be equivalent to the rms value of a sinewave input.

6-20. Specifications

Frequency Response: ±1 dB from 100 kHz to 100 MHz (relative to ac/dc transfer ratio).

AC-to-DC Transfer Ratio (23 ±5°C):

RMS Input (100 kHz)	DC Output
0.25 - 0.5V	0.25 - 0.5V ±1.5 dB
0.5 - 2.0V	0.5 - 2.0V ±0.5 dB
2.0 - 30V	2.0 - 30V ±1.0 dB

Extended Frequency Response: Useful for relative readings from 20 kHz to 250 MHz.
Response: Responds to peak value of input; calibrated to read rms value of a sine wave.
Voltage Range: 0.25 to 30V dc.
Maximum DC Input: 350V dc.
Temperature Coefficient (0 to 18°C, 28 to 50°F): ±0.1 of ac-to-dc transfer ratio specifications per °C.
Input Impedance: 12 MΩ shunted by 15 pF.

6-21. BATTERY ELIMINATOR (A81)

6-22. The A81 Battery Eliminator converts the D800 from battery to ac-line operation. It is available in a variety of line-power configurations, as shown in Table 6-1. When connected to the D800, it effectively removes and replaces the output of the D800's battery. The battery does not need to be removed from the circuit.

WARNING

DO NOT SUBSTITUTE A CALCULATOR TYPE BATTERY ELIMINATOR FOR THE A81. THESE UNITS DO NOT PROVIDE THE PROTECTION NECESSARY FOR COMMON MODE MEASUREMENTS UP TO 500V DC. ALWAYS USE THE MODEL A81 FOR AC-LINE OPERATION.

NOTES

The "BT" indicator may come on when using the A81. This does not affect the operation of the D 800.

Table 6-1. A81 Model vs Input Power

MODEL NO.	INPUT POWER
A81-100	100V ac ±10%, 48 to 62 Hz
A81-115	115V ac ±10%, 48 to 62 Hz
A81-230-1	230V ac ±10%, 48 to 62 Hz (U.S. type plug)
A81-230	230V ac ±10%, 48 to 62 Hz (European type plug)

6-23. CURRENT SHUNT (80J-10)

6-24. Introduction

6-25. The Model 80J-10 Current Shunt extends the current measuring capability of your meter to 10 amps continuous (20 amps for periods exceeding one minute) DC to 10 kHz at an accuracy of ±0.25% in excess of the voltmeter accuracy.

6-26. Specifications

Shunt: 10 amps at 100 mV.
Accuracy (18°C to 28°C):
DC to 10 kHz: ±0.25%.
10 kHz-100 kHz: Rising to 1 dB at 100 kHz typical.
Temperature Coefficient: 0.005%/°C.
Inductance: 8.3 nH in series w/0.01Ω shunt.
Overload: Up to one minute at 20A with a ¼ duty cycle for recovery after currents between 10A and 20A.
Connects to: ¾ inch center banana jacks.
Connectors: 5-way binding posts (red and black).

6-27. AC/DC CURRENT PROBE (Y8100)

6-28. Introduction

6-29. The Fluke Y8100 DC/AC Current Probe is a clamp-on probe that is used with a voltmeter, multimeter, or oscilloscope to read dc, ac, or composite (ac on dc) current measurements. The jaws on the U8100 are designed to clamp around conductors up to 3/4 inch in diameter. The pistol shape allows safe, easy, one-hand operation when making current measurement. The Model Y8100 probe is battery powered with size AA cells. It measures current to 200A dc or ac rms using most any voltmeter. Two ranges, 20A and 200A, produce a 2V output at full-range current.

6-30. Specifications

Ranges: 20A ac or dc
200A ac or dc
Rated Output: 2V at full range
Accuracy:
DC to 200 Hz: ±2% of range
200 Hz to 1 kHz: <100A add ±3% reading
>100A add ±6% reading
Calibration Cycle: 1 year
Frequency Response: dc to 1.0 kHz
Recommended Load: ≥3.0 kΩ
Temperature Range: +15°C to +35°C; for specified accuracy -10°C to +50°C; storage and operation at reduced accuracy.
Heating Limitation: Prolonged operation above 200A ac or 1 kHz can cause damage to the Y8100.
Working Voltage Rating: Core to output; 600V dc or 480V ac Max output to ground; 42V dc or 30V ac Max
Aperture Size: ¾" (19 mm) diameter

Size-Overall: 9″ x 4-½″ x 1-7/16″ (230 mm x 115 mm x 37 mm)
Weight: 14 ounces (0.4 kg), with batteries
Power: 4; "AA" cells
Battery Life: Alkaline-20 hours continuous

6-31. AC CURRENT TRANSFORMER (Y8101)

6-32. Introduction

6-33. The Model Y8101 (Figure 6-1) is a small clamp-on current transformer designed to extend the current measuring capability of an ac current meter up to 150 amperes. A clamp-on coil designed into the probe allows measurements to be made without breaking the circuit under test. This coil serves as the secondary of a 1:1000 transformer. The current-carrying conductor being measured serves as the primary.

6-34. Specifications

Current Range: 2A to 150A.
Accuracy, (48 Hz to 10 kHz): ±2%, 10A to 150A
±8%, 2A to 10A
Division Ratio: 1000:1
Working Voltage: 300V ac rms max.
Insulation Dielectric Withstand Voltage: 3 kV rms.
Maximum Conductor Size: 7/16″ (1.11 cm)

6-35. Safety Designed Test Lead Set (Y8132)

6-36. This test lead set is equivalent to the set originally supplied with the D800 multimeter. The set includes one red and one black test lead. Each probe has an anti-slip shoulder near the test tip and is connected to the multimeter via a safety-designed shrouded banana connector. This set will fit John Fluke instruments with Safety-designed input jacks.

6-37. DELUXE TEST LEAD SET (Y8134)

6-38. Introduction

6-39. The Y8134 is a deluxe test lead set. The attachments provided allow interconnection with a wide variety of leads and electronic components. Included in the kit are:

1. Two test leads (one red and one black). The Y8134 leads have shrouded banana connectors on each end.
2. Two test probes
3. Two insulated alligator clips
4. Two spade lugs
5. One squeeze hook
6. One test lead pouch
7. One instruction sheet

6-40. SLIM FLEX TEST LEAD SET (Y8140)

6-41. Introduction

6-42. The Y8134 Test Lead Set (Figure 1) consists of one red and one black 60-inch (1.52 meter) test lead, each with a standard banana plug on one end and an extendable tip probe on the other end. This flexible metallic tip conductor may be extended up to 2-1/2 inches, and is insulated to within 1/10 of an inch of its tip. This insulation reduces the chance of creating an inadvertent short circuit while using the probes in their extended configuration. Intended primarily for measuring voltages, the Y8140 leads may also be used for measuring modest currents.

Section 7
Schematic Diagrams

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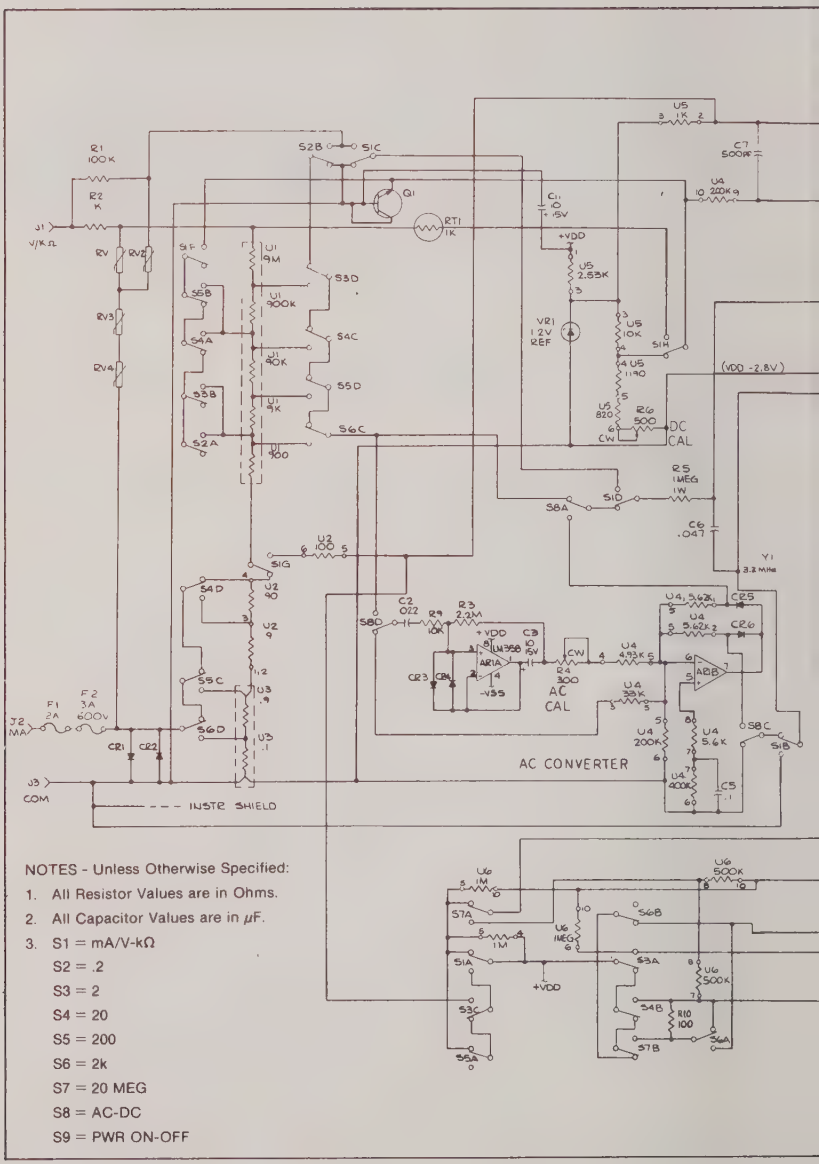
FIGURE	TITLE	PAGE
7-1.	A1 D 800 Schematic Diagram	7-3


R1 100K
R2 K
J1 V/K Ω
RV
RV2
RV3
RV4
S1F
S1B
S2A
S2B
S1C
S3A
S3B
S3C
S3D
S4A
S4B
S4C
S4D
S5A
S5B
S5C
S5D
S6A
S6B
S6C
S6D
U1 9M
U1 900K
U1 90K
U1 9K
U1 900
U2 100
U2 90
U2 9
U2 1
U3 .9
U3 .1
F1 2A
F2 3A 600V
J2 MA
CR1
CR2
J3 COM
INSTR SHIELD
Q1
C1 10 15V
RT1 1K
+VDD
U5 2.55K
VR1 1.2V REF
U5 10K
U5 1.90
U5 820
R6 500 DC CAL
S1H
S1D
S6A
R5 1MEG 1W
C6 .047
Y1 3.2 MHz
(VDD -2.8V)
C2 .022
R9 10K
R3 2.2M
C3 10 15V
LM308
AR1A
-VSS
CR3
CR4
R4 300 AC CAL
U4 4.99K
U4 33K
U4 200K
U4 5.6K
U4 400K
U4 5.62K
C25
C26
C5 .1
S6C
S1B
AC CONVERTER
U6 1M
U6 500K
U6 1MEG
S7A
S7B
S6B
S3A
S3B
S3C
S5A
S5B
R10 100
NOTES - Unless Otherwise Specified:
1. All Resistor Values are in Ohms.
2. All Capacitor Values are in μF.
3. S1 = mA/V-kΩ
S2 = .2
S3 = 2
S4 = 20
S5 = 200
S6 = 2k
S7 = 20 MEG
S8 = AC-DC
S9 = PWR ON-OFF

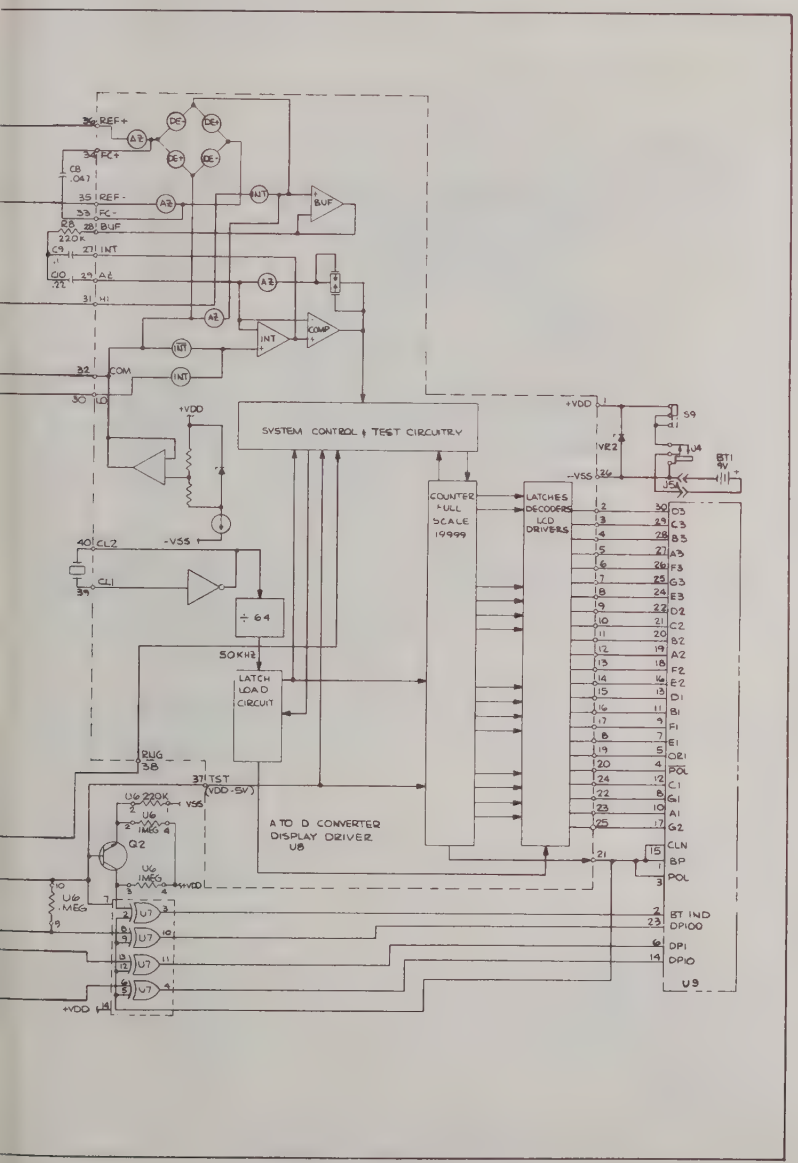


Figure 7-1. A1 D 800 Schematic Diagram

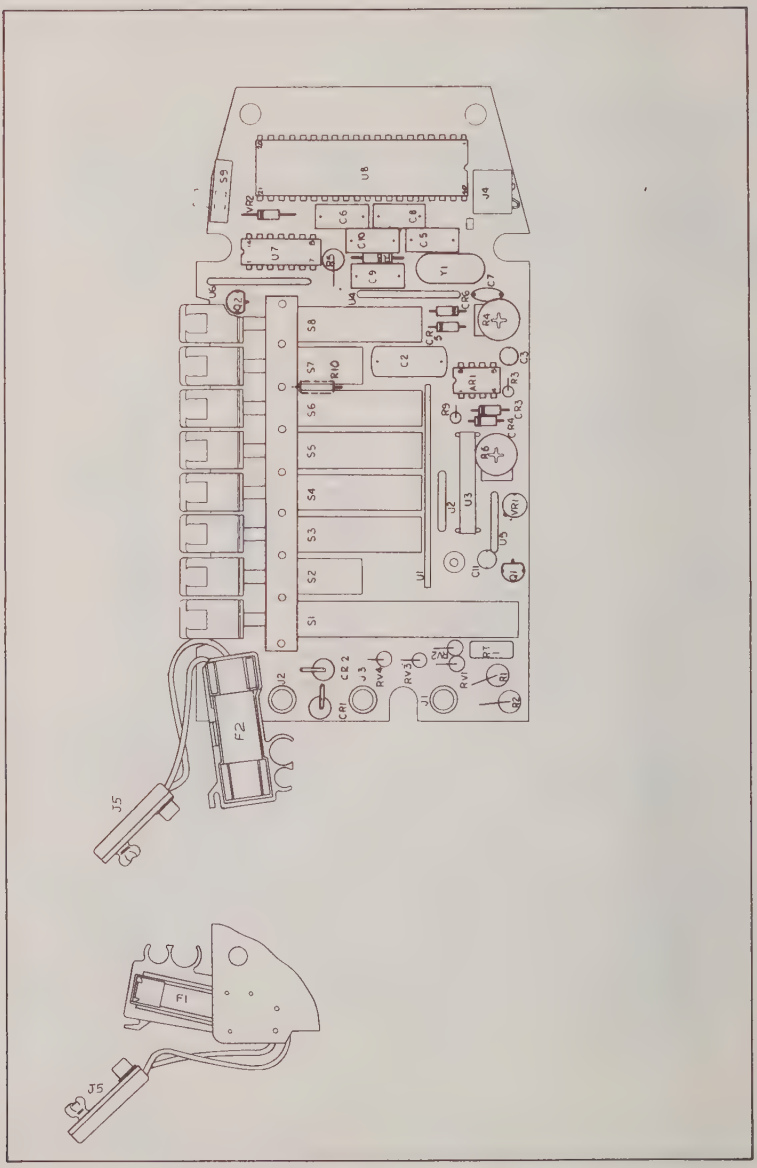


Figure 7-1. A1 D 800 Schematic Diagram (cont)

Appendix A
Manual Change and Backdating Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision level, perform the changes indicated in Table A-1.

CHANGES

There are no backdating changes at this printing. All pcb assemblies are documented at their original revision level.

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																							
			—	A	B	C	D	E	F	G	H	J	K	L	M	N	P									
A1	D800 PCB ASSEMBLY	606806	X																							

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
— = No revision letter on the PCB.

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC, will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX 43210, MOUNTLAKE TERRACE, WASHINGTON 98043, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

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Rev. 4/80

P/N 583708
October 1980
Litho in U.S.A.

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